UDOT Wildlife and Domestic Animal Accident Toolkit

Utah Department of Transportation
Environmental Services
& Wildlife & Domestic Animal Accident
Quality Improvement Team

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April 29, 2008

UDOT ENVIRONMENTAL SERVICES REPORT ABSTRACT

1. Report No.	**2. Government Accession No.**	**3. Recipient's Catalog No.**
4. Title and Subtitle: **fe and Domestic Animal Accident**	**5. Report Date: April 29, 2008** **6. Performing Organization Code:**	
7. Author(s): Paul W. West UDOT Wildlife Biologist, and Wildlife & Domestic Animal Accident Quality Improvement Team	**8. Performing Organization Report No.**	
9. Performing Organization Name and Address Utah Department of Transportation Environmental Services Division 4501 South 2700 West - Box 148450 Salt Lake City, Utah 84114-8450	**10. Work Unit No.** **11. Contract No.**	
12 Sponsoring Agency Name and Address Utah Department of Transportation Environmental Services Division 4501 South 2700 West - Box 148450 Salt Lake City, Utah 84114-8450	**13. Type of Report and Period Covered** **14. Sponsoring Agency Code**	
15. Supplementary Notes:		

16. Abstract:

Since the original report, WILDLIFE & DOMESTIC ANIMAL-VEHICLE COLLISIONS, was published much of the data contained therein was in need of being updated. This report, titled UDOT WILDLIFE AND DOMESTIC ANIMAL ACCIDENT TOOLKIT, contains some updates of the data plus more information regarding wildlife and domestic animal accident hotspots has been added, including updated accident data and wildlife connectivity data taken from the report, WILDLIFE CONNECTIVITY ACROSS UTAH'S HIGHWAYS – UPDATED. Additionally, more toolkit information has been added to give project managers, planners, design engineers, etc., more tools to work with to help keep animals off the rights-of-way and roadways.

17. Key Words: Wildlife, Domestic Animal, accidents, prevention, safety, mitigation, toolkit	**18. Distribution Statement** Available: UDOT Environmental Services Division Box 148450 Salt Lake City, Utah 84114-8450

19. Security Classification (Of this report)	**20. Security Classification (Of this report)**	**21. No. of Pages** **61**	**22. Price**

ACKNOWLEDGEMENTS

Special thanks to the members of the Wildlife QIT: Michelle Page, UDOT Research Program Manager; Paul West, UDOT Wildlife Program Manager; Richard Miller, UDOT Preconstruction Engineer; Kevin Nichol, UDOT Program Development Manager; Rob Clayton, UDOT Traffic & Safety Manager; and Gregory Punske, FHWA Utah Environmental Program Manager. This toolkit is the result of their countless hours spent reading, reviewing and developing.

Additional thanks to Michael Canning, Conservation Data Coordinator for the Utah Department of Natural Resources, Division of Wildlife Resources and the regional habitat managers for reviewing and providing valuable comments. Also, John Bissonette, Utah State University's College of Natural Resources/USGS Utah: Cooperative Fish & Wildlife Research Unit Research Scientist Leader whose efforts in the field, along with those of his associates and graduate students, continue to provide valuable data collection information.

And thanks too to the many UDOT Maintenance personnel who reviewed the findings of the Wildlife QIT and provided additional information on a regular basis. Their continuing efforts in identifying and coordinating animal-vehicle collision locations will keep this a living document.

WHAT'S CHANGED?

Since the original report, WILDLIFE & DOMESTIC ANIMAL-VEHICLE COLLISIONS, was published much of the data contained therein was in need of being updated. This report, titled UDOT WILDLIFE AND DOMESTIC ANIMAL ACCIDENT TOOLKIT, contains some updates of the data plus more information regarding wildlife and domestic animal accident hotspots has been added, including updated accident data and wildlife connectivity data taken from the report, WILDLIFE CONNECTIVITY ACROSS UTAH'S HIGHWAYS – UPDATED. Additionally, more toolkit information has been added to give project managers, planners, design engineers, etc., more tools to work with to help keep animals off the rights-of-way and roadways.

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BACKGROUND INFORMATION

Summary

The recent federal legislation titled SAFETEA-LU, states, "The Secretary is to conduct a Wildlife Vehicle Collision Reduction Study of methods to reduce collisions between motor vehicles and wildlife." Over the 14-year period from 1992 thru 2005, the Utah Highway Patrol reported to UDOT's Traffic and Safety Office that nearly 30,500 wildlife-vehicle collisions (WVC) had occurred during that period, most reported being deer, elk, and moose. The number of reported injury accidents during this period was 2,030. This includes 18 reported deaths due to accidents with wildlife. Table 1 below depicts the trend in this accident rate. While the trend shows an improvement in the overall accident rate, Table 2 (page 2 below) shows that the injury and fatality rate has increased over this same period.

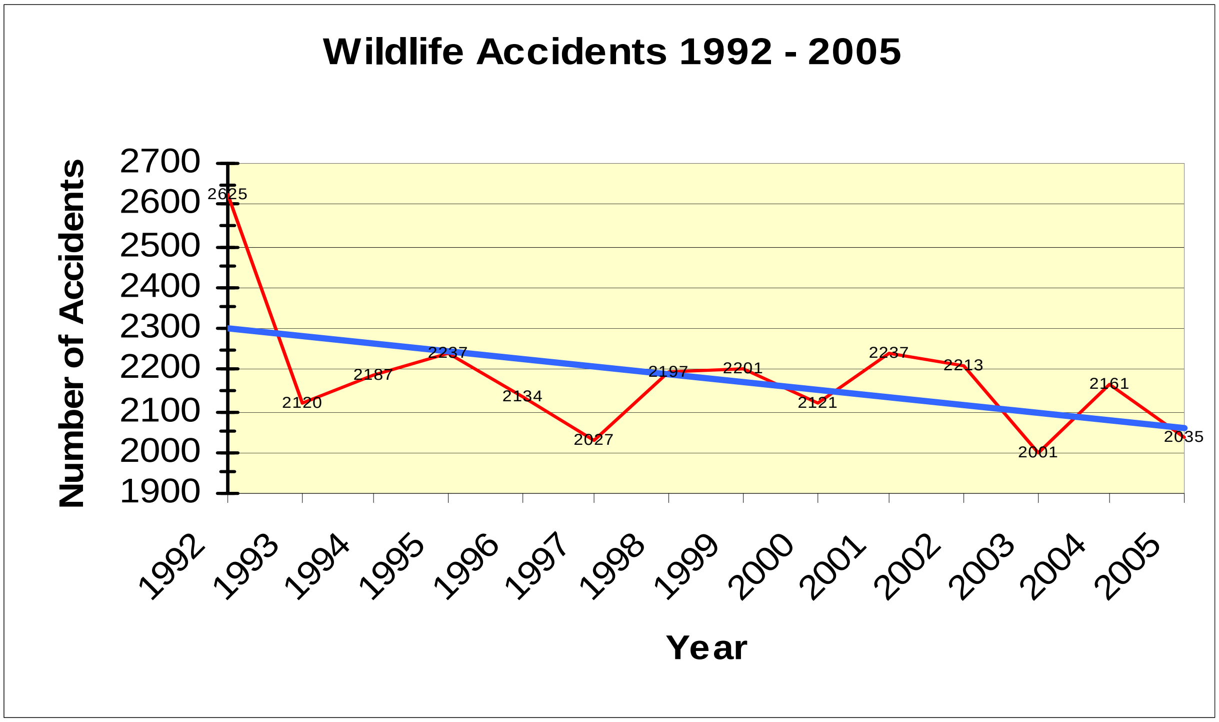

Table 1

Throughout the rest of the United States, as well as in Canada and Europe, deer-vehicle collisions (DVCs) are increasing[1,2,3,4]. In addition to human dangers associated with DVCs, local deer populations are being significantly impacted[5].

Numerous studies have been performed in Arizona, Colorado, Montana, Florida, Nebraska, and other states, as well as in Canada and many countries in Europe, that have identified numerous countermeasures to reduce WVCs. The Federal Highway Administration (FHWA), Transportation Research Board (TRB), American Association of State Highway Transportation Officials (AASHTO), along with other transportation agencies, have also participated in studies to determine the effectiveness of various countermeasures. Within UDOT, several countermeasures have been tried with varying rates of success. Knowing there were numerous studies available regarding WVCs, the

Utah Department of Transportation (UDOT) managers recommended a Quality Improvement Team (QIT) be organized to evaluate what needs to be done in Utah. This toolkit is the result of the efforts of that QIT.

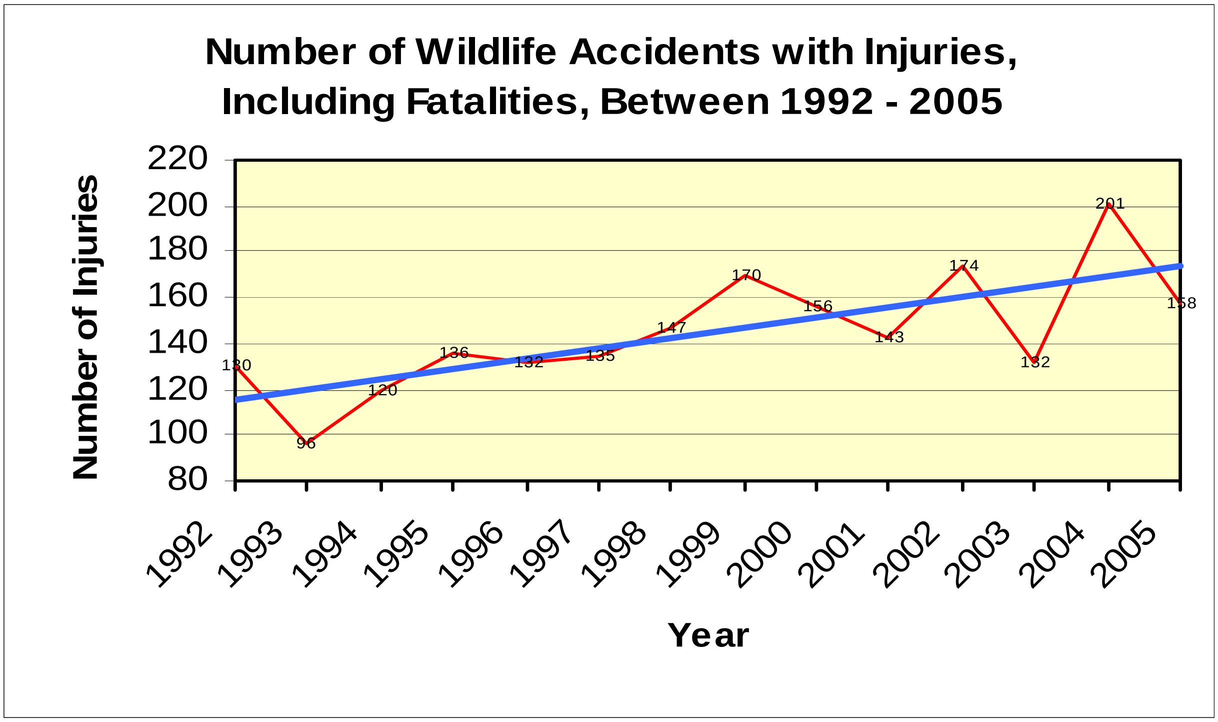

Table 2

The original purpose of the Wildlife QIT was to coordinate team efforts regarding WVCs from the initial planning phase of a "project" thru the maintenance phase – a "project" being defined as any roadway improvement on a state or federal route. However, early on in the QIT meetings, it was determined that many domestic animal-vehicle collisions (DAVCs) were as significant as WVCs, and the team recommended including Domestic Animal/Vehicle collision data in this toolkit as well.

This toolkit is the result of the research into wild and domestic animal-vehicle collisions. It contains a summary of information regarding animal/vehicle collisions that can be used consistently throughout the Department and be updated as needed to reflect current practices. This report is not a step-by-step manual on how to fix every area where there is an animal-vehicle collision, rather a single source document with ideas and suggestions compiled from experiences in Utah and North America, as well as abroad.

Data Collection

Literature Search

The first step for the Wildlife QIT was to determine what information was available regarding wildlife-vehicle collisions and countermeasures. An in-depth literature search provided study information from other states, Canada and Europe. Also, product information was collected, reviewed, compiled, and discussed resulting in lessons learned or a “toolkit” approach. The QIT proposed to provide all areas of UDOT with a list of animal/vehicle countermeasures, and where possible the effectiveness of these countermeasures.

Additionally, the Wildlife QIT looked at all available studies conducted in Utah regarding wildlife and transportation issues, as well as domestic animal/vehicle collisions. Several university studies were found as well as some studies conducted by UDOT that had not been published. This information was evaluated and a new list of countermeasures specific to Utah was developed. In addition, regional experts were identified, contacted, and visited to determine what ongoing studies were available.

Collection of Animal – Collision Data

The next step for the Wildlife QIT was to determine what data was available regarding animal-vehicle collisions in Utah.

UDOT’s Traffic & Safety Division tracks accident data reported by local and state law enforcements officers in their Crash Data Almanac. This system is available to UDOT employees. The data can be sorted with simple filters (route, milepost, type of hit, date, time of day, etc.). Then it can be mapped and printed as needed. The principle weakness of this data is: 1) not all accidents are reported; 2) only those accidents with at least $1,000 worth of damage are reported; and 3) many wildlife-related accidents go unreported as such if the reporting officer fails to see the animal. However, with regard to comparability and repeatability this data source currently appeared to be the most reliable, and could show where most accidents are likely to be occurring.

In addition to the Traffic and Safety data, each region within UDOT has carcass removal contracts with private contractors for some of its routes, but not all. It was quickly noted that each region also handles the removal, payment, and tracking of animals differently. Some require reporting of carcasses removed by date and milepost. Others do not. This raised several concerns: ability to compare data statewide, repeatability, and ease of evaluation of the data.

The Utah Division of Wildlife Resources (UDWR) and UDOT maintenance personnel also track some animal-vehicle collisions. In addition, Dr. John Bissonette with the University of Utah has gathered information on select projects throughout the state. These sources provide a good check against UDOT’s Traffic and Safety data, but they neglect domestic animal-vehicle collisions, and are not readily available to UDOT personnel to evaluate on a regular basis.

In conclusion, for this updated Wildlife QIT report, it was decided to use the UDOT Traffic & Safety Crash Data Almanac to gather animal-vehicle collisions per route over the three-year period of 2003-2005, which is the latest data that has been made available by Traffic and Safety.

Hot Spot Development
As the Wildlife QIT analyzed animal-vehicle collisions on each route, the focus was placed on developing a consistent approach for all the divisions within UDOT to follow when addressing animal-vehicle conflicts.

Current “hot spots” were identified based on the latest three-year period for which UDOT’s Traffic and Safety Division data was available (2003 to 2005), and listed individually to give a starting point for any of the approaches recommended in this toolkit.

Nearly all of Utah’s roadways were found to have animal-vehicle collisions. The main task was to identify where the greatest number of those collisions were occurring. To accomplish this, the following criteria were used:

- Domestic Vehicle Collision “Hot Spots” (3 or More Accidents/Mile/3 years)
- Wildlife Vehicle Collision “Hot Spots” (10 or More Accidents/Mile/3 years)

COSTS VERSUS BENEFITS
Table 3 below, indicates the animal-vehicle accident severity and costs, gathered as part of a University of Utah Study commissioned by UDOT’s Research Section[6] (the cost figures on this table have been updated for this updated report).

The figures in the table are based on 2008 FHWA crash costs for vehicle damage and injury only. They do not include the UDOT expenses for carcass removal ($125.00/mile/year)[7], nor do they include the cost of delay to the traveling public (estimated at $13.00/person/hour[8]).

Table 3 – Animal-Vehicle Accident Severity and Costs (1992 – 2005)

		Wild		Domestic		
Severity	Cost Per Accident[9]	Number of Accidents[10]	Cost in Millions	Number of Accidents[11]	Cost in Millions	Total Cost in Millions
1	$4,462	28,450	$126.9	4,583	$20.4	$147.3
2	$42,385	945	$40.0	460	$19.5	$59.5
3	$80,308	654	$52.5	399	$32.0	$84.5
4	$401,538	417	$167.4	327	$131.3	$298.7
5	$5,380,000	14	$75.3	21	$113.0	$188.3
	Total	21,932	$462.1	5,790	$186.7	$778.3

Note: The accident severity number corresponds to the following: (1) No Injury; (2) Possible Injury; (3) Bruises and Abrasions; (4) Broken Bones or Bleeding Wounds; and (5) Fatal.

For example, on high volume freeway segments, which can carry 2,090 passenger car equivalent per lane per hour[12], an accident which closes traffic lanes would cost the traveling public an additional $26,000 per lane/hour in delays[i].

Not represented in the costs in the table above, the UDWR estimates the value of a deer or elk at $488 per year of age (i.e. a 3-year-old deer would be valued at $1,464.00). This is based on the hunting-related expenses divided by the combined herd sizes. Looking at the hunting-related expenses divided by the number of harvested animals the dollar value jumps substantially to $4,108. Somewhere between these values are the restitution values the Utah Code prescribes for illegal taking, possession, or wanton destruction of protected wildlife: $750 per animal for elk, $400 per animal for deer, and $8,000 per animal for trophy elk or deer. For this report, the QIT suggested using the value of $1,500 per wild animal[13]. For additional figures directly related to deer-vehicle collisions, see John Bissonette's current research at http://www.deercrash.com[14].

For domestic animals, the typical value of a horse in Utah ranges from $1500 to $2500, with exceptions for racing or breeding stock (which can cost well into the tens of thousands of dollars). Typical cattle prices range from $2000-$4000 depending on the weight, with exceptions for breeding stock which can also sell in the thousands to ten thousands of dollars[15].

Using the figures listed above, a benefit/cost ratio can be calculated by multiplying the average annual crash costs times the design life expectancy, of the crash prevention measure, then dividing this number by the estimated cost of the crash prevention measure (see equation below). The design life expectancy may vary depending on the collision counter measure. For example, a sign with flashers might have a design life of 5 years whereas a wildlife crossing structure would have a design life of 30 years or more, with minimum maintenance.

$$\text{Benefit/Cost} = \frac{\text{Average Annual Crash Costs x Design Life (years)}}{\text{Estimated Project Cost}}$$

For a measure to be considered, the benefit/cost ratio should be sufficient to justify the cost of the crash prevention measure, usually a ratio of 1 or better.

WILDLIFE AND DOMESTIC ANIMAL "HOT SPOTS"

Wildlife Accidents

As stated above, wildlife "Hot Spots" are defined for this report as any stretch of highway where the Traffic and Safety data indicates the number of wildlife/vehicle accidents is 10 or more per mile over the three-year period 2003 to 2005. It is estimated

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[i] $26,000 is the average annual crash cost determined by the delay cost to the traveling public of $13.00/person/hour times the passenger car equivalent per lane per hour, which is 2090 for a high volume freeway segment. The result being $26,170, rounded to the nearest thousand to an estimate of $26,000/lane/hour in delays.

by wildlife biologists with the Utah Division of Wildlife Resources that this data may only represent from 1/3 to 1/10 the actual number of wildlife/vehicle accidents[16,17].

Figure 1 (on page 7 below) shows the approximate locations of WVC "Hot Spots" throughout the state between the years 2003 and 2005. Table 4 (beginning on page 9), list the Wildlife/Vehicle Accident "Hot Spots" by UDOT region, route, and approximate mileposts[18]. For more details, see the graphs of Wild Animal Accidents in Appendix A. On these graphs, accident rates for 5 miles in both directions of the "Hot Spot," were included where available.

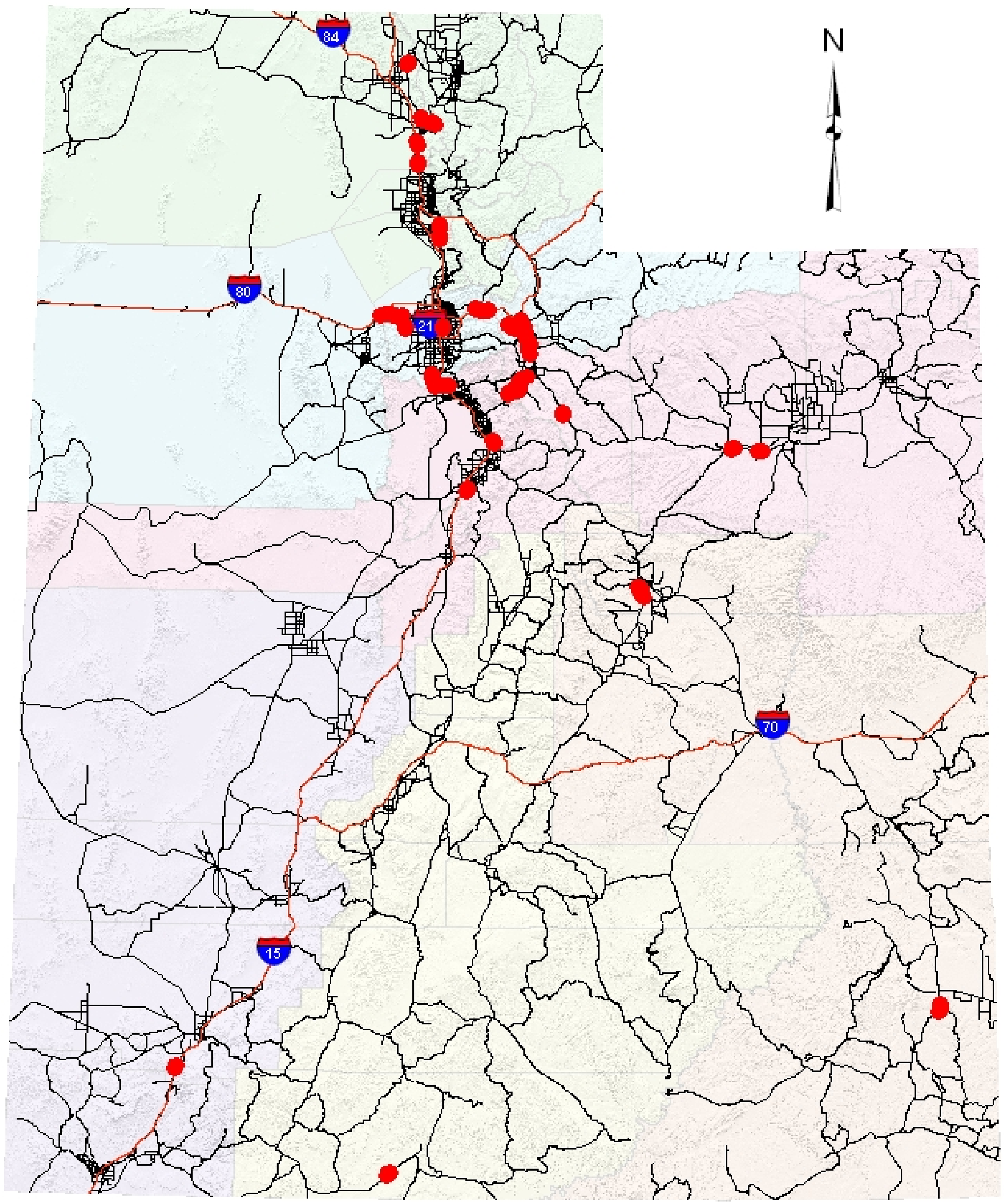
Wildlife Connectivity

In 2004, UDOT sponsored a workshop to identify major sections of Utah's highways that serve to disrupt wildlife movements, or wildlife connectivity. This workshop was attended by representatives of the UDOT (including Environmental Services, Planning, Research, and Regional personnel), UDWR, U.S. Forest Service, School Institutional Trust Lands Administration, private conservation and consulting groups, and students and professors from Utah State University.

During the workshop, and subsequently in some of the UDWR offices, 64 separate connectivity zones were identified throughout the state. These were prioritized based on the professional opinions and the experience of biologists who were familiar with the linkage zones, or connectivity areas. From this, it was estimated that 222 miles of Utah's roads and freeways cross through what are considered critically important linkage zones, 287 miles of roads cross through highly important zones, and 754 miles cross through moderately important priority areas.

Figure 2 (on page 8 below) is a map of the identified connectivity zones along with the priorities assigned to each zone. Each connectivity zone is discussed in detail in the appendix of the report entitled, Wildlife Connectivity Across Utah's Highways – Updated (October 2007)[19]. The information contained in this report can be useful in planning long-range highway corridor studies as well as short-range projects, even maintenance projects where wildlife mitigation measures are not costly. The wildlife connectivity data is also included in Table 4 (Page 9) for comparison with the wildlife/accident hot spots.

Wildlife/Vehicle Accidents



2003 thru 2005

Figure 1

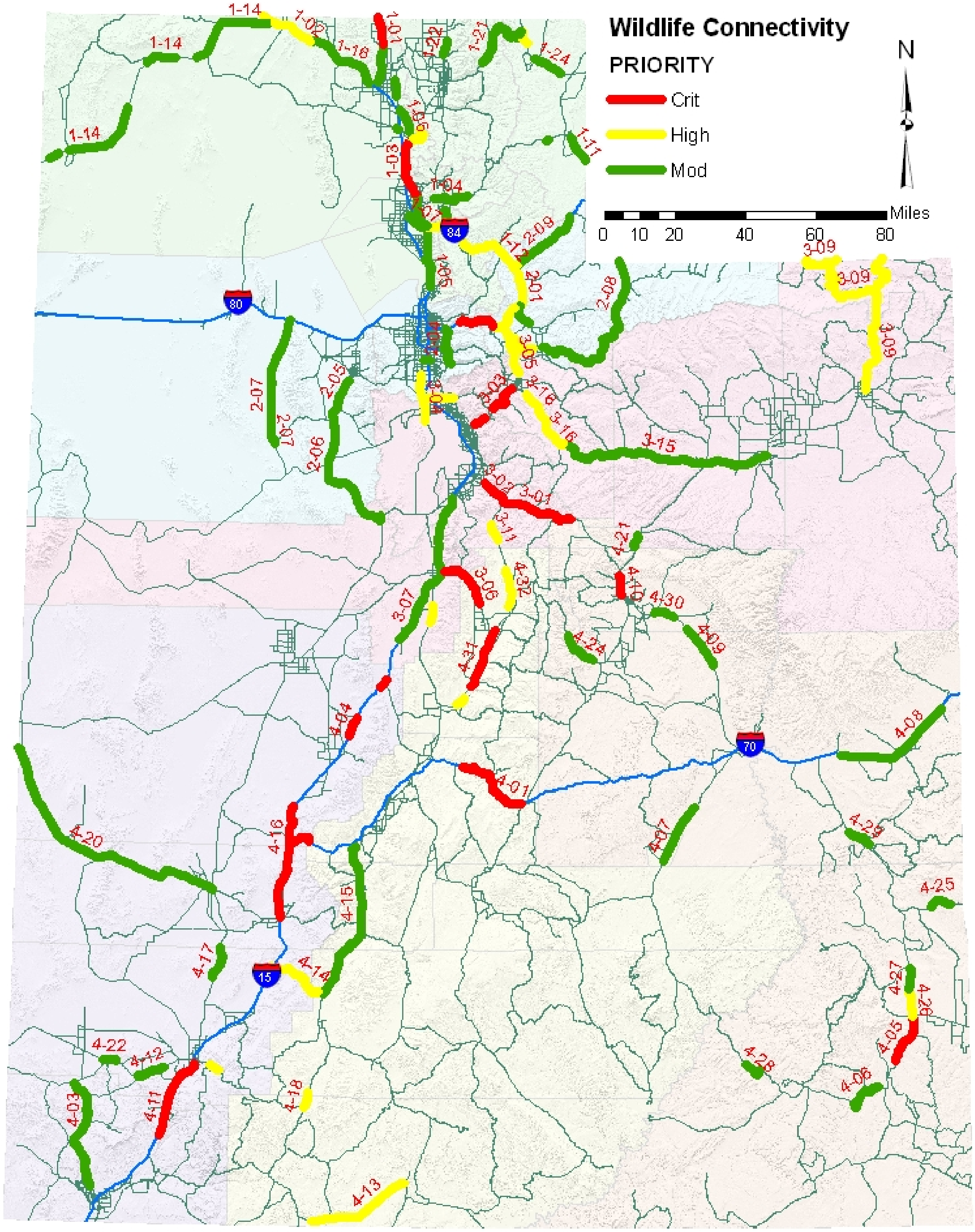

Wildlife Connectivity
PRIORITY
Crit
High
Mod
N
Miles
0 10 20 40 60 80

Figure 2

TABLE 4 Wildlife/Vehicle Accident Hot Spots”
(Ten or More Accidents/Mile – 2003 to 2005)

REGION 1

Route	Mile Posts	# of Accidents	Wildlife Connectivity Priority
SR-38	1 – 2	13	Low
SR-38	18 – 19	10	Low
U.S. 89	400 – 401	12	Moderate
U.S. 89	403 – 404	11	Moderate
U.S. 89	424 – 425	13	Critical
U.S. 89	430 – 431	27	Critical
U.S. 91	8 – 9	27	High

REGION 2

Route	Mile Posts	# of Accidents	Wildlife Connectivity Priority
U.S. 40	2 – 3	10	High
U.S. 40	3 – 4	11	High
SR-68	36 – 37	27	High
SR-68	37 – 38	11	High
SR-68	38 – 39	10	High
I-80	133 – 134	12	Critical
I-80	134 – 135	11	Critical
I-80	136 – 137	11	Critical
U.S. 89	372 – 373	11	Low
SR-111	7 – 8	10	Low

REGION 3

Route	Mile Posts	# of Accidents	Wildlife Connectivity Priority
U.S. 40	6 – 7	25	High
U.S. 40	7 – 8	14	High
U.S. 40	8 – 9	25	High
U.S. 40	10 – 11	14	High
U.S. 40	11 – 12	12	High
U.S. 40	12 – 13	12	High
U.S. 40	33 – 34	10	High
U.S. 40	88 – 89	14	Moderate
U.S. 40	96 – 97	15	Moderate
SR-68	35 – 36	15	High
U.S. 89	330 – 331	12	Low
SR-92	0 – 1	12	High
SR-92	1 – 2	11	High
U.S. 189	17 – 18	13	Critical
U.S. 189	19 – 20	13	Critical
U.S. 189	22 – 23	10	Critical
U.S. 189	26 – 27	11	Critical
SR-198	1 – 2	11	Low

REGION 4

Route	Mile Posts	# of Accidents	Wildlife Connectivity Priority
U.S. 6	221 – 222	10	Low
U.S. 6	222 – 223	13	Low
U.S. 6	223 – 224	12	Low
I-15	46 – 47	11	Critical
U.S. 89	39 – 40	10	High
U.S. 191	66 – 67	11	Critical
U.S. 191	67 – 68	13	Critical

Domestic Animal Accidents

Domestic Animal "Hot Spots" are defined for this report as any stretch of highway where the Traffic and Safety data indicates the wildlife/vehicle accident rate is 3 or more over the three-year period of 2003 to 2005.

Table 5 below lists the Domestic Animal/Vehicle "Hot Spots" by UDOT region, route, and approximate mileposts[20]. As with the wildlife data, the accidents on a stretch of 5 miles in either direction of the "Hot Spot" were included in the graphs in Appendix B, where available.

TABLE 5 Domestic Animal/Vehicle Accident "Hot Spots"
(Three or More Accidents/Mile – 2003 to 2005)

REGION 1

Route	Mile Posts	# of Accidents	Wildlife Connectivity Priority
SR-16	18 – 19	3	Low
SR-30	6 – 7	3	Low
SR-30	105 – 106	3	Low
SR-39	66 – 67	3	Low
U.S. 89	482 – 483	7	Moderate
U.S. 89	484 – 485	3	Moderate
U.S. 91	19 – 20	3	Low
U.S. 91	24 - 25	3	Low

REGION 2

Route	Mile Posts	# of Accidents	Wildlife Connectivity Priority
SR-32	10 – 11	4	Low
I-80	142 – 143	3	High

REGION 3

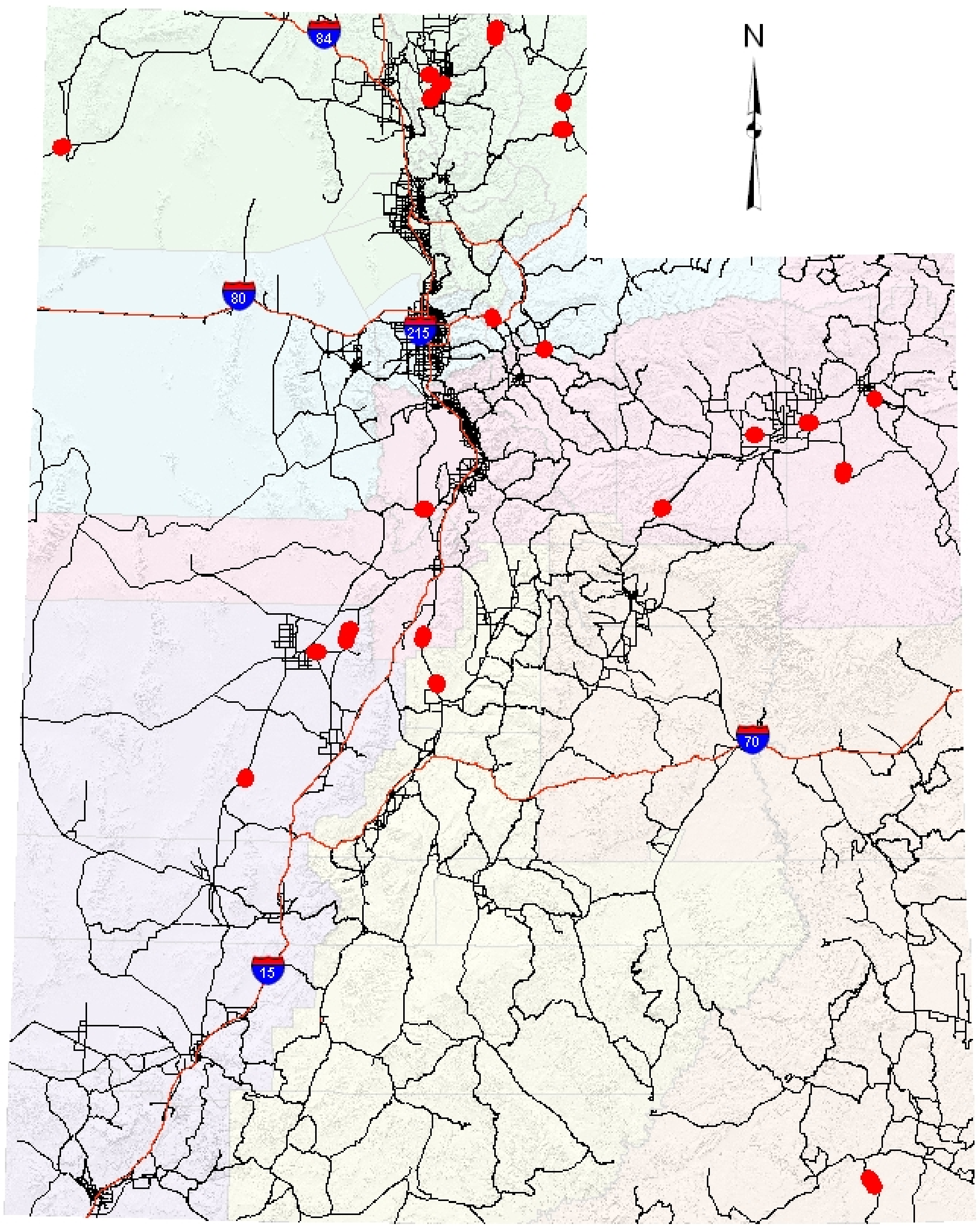
Route	Mile Posts	# of Accidents	Wildlife Connectivity Priority
U.S. 6	151 – 152	4	Low
SR-28	19 – 20	3	Low
U.S. 40	121 – 122	3	Low
SR-45	38 – 39	3	Low
SR-87	33 – 34	3	Low
SR-88	0 – 1	4	Low
SR-88	1 – 2	4	Low
U.S. 191	274 – 275	3	Low

REGION 4

Route	Mile Posts	# of Accidents	Wildlife Connectivity Priority
SR-28	5 – 6	4	Low
U.S. 89	132 – 133	3	Low
SR-125	0 – 1	4	Low
SR-125	11 – 12	4	Low
SR-125	13 – 14	3	Low
SR-125	14 – 15	5	Low
U.S. 191	12 – 13	6	Low
U.S. 191	14 – 15	3	Low
SR-257	32 – 33	3	Low

Figure 3 below is a map showing the approximate locations of the domestic animal/vehicle accident hot spots[21].

Domestic Animal/Vehicle Accidents



2003 thru 2005

Figure 3

Functional Classification/Prioritization of State Routes

In addition to looking at "hot spots," emphasis should also be placed on reducing vehicle conflicts with wildlife and domestic animals on the highways that have the highest functional classifications. The Interstate Highway system and principal arterials are rated as having the highest functional classes of roadway systems and carry highest volumes of traffic, especially in urbanized areas. The wildlife QIT recommended prioritizing these routes and focusing efforts on solving conflicts on these critical transportation facilities. Roadways on the National Highway System (NHS), which includes the Interstate system, and important principal arterial roadways are eligible for an additional funding under the Federal-aid NHS program.

Functional Classification Maps are available from UDOT's web site: http://www.udot.utah.gov/index.php/m=c/tid=1224.

These maps will be next updated in 2008, and again after the 2010 Census results are made available. Questions concerning the Functional Classification Maps can be directed to UDOT Program Development Unit.

THE PROCESS

Planning

UDOT Systems Planning and Programming, in cooperation with municipal planning organizations and resource agencies, should identify and recommend AVC prevention measures for "Hot Spot" area projects as part of UDOT's Long Range Plan. "Hot Spot" areas, where other improvements are not part of the Long Range Plan, may be called out as separate projects. Appropriate funding levels would then be allocated for the actions proposed.

Early Project Examination/Identification

Planners use Prioritization Mechanisms, and perhaps GIS analysis, in determining priorities and budgeting. They should also emphasize early identification of wildlife and domestic animal issues during NEPA scoping efforts.

The Planning divisions, both those in the Central Office as well as the regional planners, have access to GIS data to help them make determinations of wildlife impacts for every project. So far, such data consists of the following:

- Wildlife/Vehicle Accident Data (from Traffic and Safety database)
- Domestic Animal/Vehicle Accident Data (from Traffic and Safety database)
- Carcass Removal Data (from contractors, UDOT maintenance, and UDWR)
- Wildlife Connectivity Data (from UDOT Wildlife Biologist and the report, Wildlife Connectivity Across Utah's Highways[22])
- Threatened and Endangered Species Data (from UDOT Wildlife Biologist)
- State Sensitive Species Data (from UDOT Wildlife Biologist)
- Statewide Critical and Sensitive Habitats Data (from UDOT Wildlife Biologist)

With the help of these data sets, planners should be able to identify areas needing further analysis. Such analyses can be corridor studies such as those recently done on I-70 and U.S. 6, and currently underway for I-80. With these studies in hand, planners can propose wildlife protection measures early in the project definition and selection process. This facilitates early identification of issues during the NEPA scoping, and while prioritizing projects to be added to the statewide transportation improvement program (STIP).

Early Environmental/Planning Coordination

UDOT Planning and Environmental divisions need to work together to improve communication and to better integrate environmental considerations into planning (NEPA) activities with the goal of a virtually seamless NEPA environmental process beginning from planning and continuing through programming, design, permitting, construction, and maintenance. Early consideration of wildlife and domestic animal crash "hot spots" along with wildlife connectivity data, will allow UDOT to develop potential remedies, with costs based on existing data and proposed improvements, and will provide more accurate estimates of overall project costs before the projects are programmed and financed in the STIP.

Long Range Plan for Costly Projects

Many animal crash prevention measures will be too costly to perform as part of normal Region operations such as spot improvements, and contingencies. Overpasses and underpasses are key examples. Wildlife-proof fencing with wildlife escape ramps may also fall into this category, depending on length and terrain. In these cases, proposed mitigation measures will need to be added to statewide, or metropolitan Long-Range Plans (LRPs), or considered as separate STIP items.

The UDOT long-range transportation plan lists projects larger than those covered by maintenance or preservation activities. These projects include pavement reconstruction, shoulder widening, adding travel lanes, constructing new or rebuilding older interchanges, constructing new highway alignments, and other capital-intensive projects. Project limits are typically defined by the highway maintenance section, except for new alignments and localized improvements such as interchanges, bridges, and large-scale spot safety projects. Some proposed animal protection measures and their projected costs should be included in the detailed descriptions for each project. Where a priority "hot spot" is identified on a highway section not slated for other improvements, a separate mitigation project should be added to the long-range project list.

Projects are added to the long-range plan in a number of ways, including Region input, public and resource agency comments, asset management, corridor studies, and local transportation master plans. One of the most effective ways to ensure needed mitigation measures are added to the long-range plan is to coordinate with the UDOT Planning Section as individual corridor studies are being prepared. In this way, these measures would be included with other identified needs, along with their estimated costs.

In urbanized areas (Salt Lake – Ogden, Utah Valley, Dixie, Cache Valley), metropolitan planning organizations have the primary role for transportation planning in partnership with UDOT. Their plans are prepared separately, then integrated into the statewide plan, or STIP. UDOT's Environmental staff, resource agencies, and other's who want to include wild and domestic animal mitigation measures into the plans for local and state roadways in urbanized areas should coordinate with these agencies.

Statewide Transportation Improvement Plan (STIP)

A proposed project must appear in the Statewide Transportation Improvement Program (STIP) before development funds can be expended. Each year, the regions work with UDOT's Programming Section, UDOT leadership, and the Utah Transportation Commission to determine which projects in the LRP have highest priority and should be forwarded to the STIP, either in the Concept Development phase or directly in a funded year. In anticipation of this process, each region may request that a detailed corridor study be performed to better understand the corridor needs, project limits, level of environmental analysis needed, and anticipated costs. During this process, specific mitigation measures should be recommended for any animal-accident "hot spots" identified within the corridor as part of these pre-STIP corridor studies.

Project Development

When projects encompassing "hot spots" are advanced to the Concept Development phase of the STIP, any existing animal-vehicle crash prevention measures should be re-evaluated to determine the following:

1) measures remain appropriate and adequate;
2) allocation of funding is adequate; and
3) benefit-to-cost ratio of improved mitigation measures is favorable to the Department as well as to the traveling public.

When a project moves to a funded year, animal-vehicle crash prevention should be part of the project's "Purpose and Need," and an appropriate range of measures should be evaluated as part of the National Environmental Policy Act (NEPA) process which will help in the selection of the most appropriate mitigation measure(s). During the final project design, the region environmental staff should ensure that all NEPA document commitments are implemented, including all animal-vehicle crash prevention measures.

HIGHWAY DESIGN OPTIONS

Wildlife

Numerous design options are available that can help highway designers provide wildlife with opportunities to safely cross roadways and result in reduced WVCs. Implementation of these design options can be optimized when located near migration routes, or where animals naturally approach and cross the road.

No single set of variables identifies a preferred wildlife crossing location. Every highway landscape is unique and requires mitigation measures to be determined and located individually for each project by wildlife experts. According to Barnum (2003) “Although wildlife-vehicle collisions cannot be predicted, their occurrence is not random in time or space.[23]” Huijser, et. al. also stated, “Landscape spatial patterns can concentrate or funnel animals onto certain road sections, whereas certain road attributes can make a motorist less likely to observe wildlife or less able to respond in time.[24]”

Once a “hot spot” has been identified, guidelines for analysis and Identification of suitable crossing areas for various wildlife species should include the following:

- Wildlife migration patterns
- Habitat suitability
- Landscape structure and its interaction with migration patterns and habitat suitability
- Highway design influences on habitat suitability and landscape structure

Design Considerations

<u>Highway Placement:</u>
Roads bisect natural habitats, ranges, and migration routes, restricting animal movements. Some species, principally nesting avian species, often avoid highways altogether for up to a mile. Thus, characteristics of the surrounding landscape, assessment of migration routes and wildlife crossing areas, are important in determining which sections of highway are most frequently crossed by wildlife.

<u>Highway Design:</u>
The location of roadside barriers and structures such as fencing, jersey barriers, underpasses, overpasses, width of pavement, etc., can significantly impact where animals cross.

Features of Conflict Zones or “Hot Spots”

Highway segments most frequently crossed by wildlife include segments indicated as high accident segments by UDOT Traffic and Safety accident data, carcass removal data, tracking data, or professional and personal knowledge.

Features that correlate with suitable habitat include linear guide ways that encourage or discourage wildlife crossing, depending on orientation to the roadway, slope steepness and complexity, distance to cover, etc.

Design-Based Approaches To Reduce Wildlife/Vehicle Conflicts

To obtain successful reduction of WVCs, designers must take into consideration the structure of the surrounding landscape, highway design, and species (see mitigation measures below). A combination of wildlife habitat features on the roadside, along with the unique design of the highway, can be used to optimize crossing locations. Placing crossing structures at, or near, natural crossing areas are usually the most successful in reducing WVCs.

On low volume, low speed roads, crossing structures are not always necessary. To reduce wildlife collisions on such roads the barrier effects of the highway, such as excessively wide travel lanes, jersey barriers, cut banks, steep fill slopes, etc., should be minimized to allow wildlife to cross unhindered. In addition, trees, boulders, buildings, etc. in the right-of-way should be removed to improve driver's sight-distance.

On high volume, high-speed roads, crossing structures, such as wildlife underpasses and overpasses, coupled with exclusionary wildlife fencing and escape ramps, will often be needed to accommodate animal movements. These structures need to be coordinated with UDOT's wildlife biologist and the Utah Division of Wildlife Resources.

(Note: This option requires exclusionary fencing for a minimum of 1 mile in each direction from the crossing on both sides of the roadway for a total of 4 miles of fencing. Escape ramps are also required at the entrance of the crossing and spaced at approximately 1/4- to 1/3- mile intervals. These need to be coordinated with the UDOT Wildlife Biologist and UDWR. An escape ramp is an earthen structure that allows wildlife caught in the right-of-way an avenue of escape. See UDOT Standard Drawings FG Series.)

Other Considerations

- Permanent Signing
- Temporary Signing
- Exclusionary Fencing (8 foot high Type-G Wildlife Barrier) including Wildlife Escape Ramps
- Location of wildlife under/overpass crossings in natural crossing areas
- Roadside Vegetation Management
  - Mowing or clearing of Right of Way
  - Planting of low growing, unpalatable vegetation
- Geometric Considerations:
  - Speed limits
  - Curve radii
  - Lane widths
  - Height and length of wildlife overpasses and underpasses

Possible Solutions

- Exclusionary fencing (V-mesh, 8 feet high), including wildlife escape ramps *(See UDOT Standard Drawings FG Series)*
- Bridges: ("These have proven much more effective than box, or corrugated steel culverts, for getting animals to cross underneath a freeway, particularly with regard to elk." [Personal communication with Bruce Bonebrake, UDWR Habitat Manager]).
- Overpasses
  - Location of structures in natural crossing areas
- Culverts (box and steel arch):
  - Location of structures in natural crossing areas
  - Design using natural bottom and 2:1 natural substrate side slopes in structures
  - Minimum vertical and horizontal clearances for underpass structure:
    - 16 feet for elk

        - 8 feet for deer
    - 23 feet wide or greater
    - Aspect to length index of 2.7 (English measuring units) or greater
    - Maximize daylight area:
    - Use 2:1 slope sidewalls where possible with natural dirt substrate on sloped sides and floor
    - Daylight underpasses in center median where possible

Domestic Animals

Design options to reduce domestic animal accidents on roadways include:

Identification Criteria for Design Options

- Based on accident data from UDOT's Traffic and Safety Division.

Design-Based Approaches To Reduce Domestic/Vehicle Conflicts

- Right-of-Way Fencing – UDOT Standard Drawings FG Series
- Swing Gates – UDOT Standard Drawings FG Series
- Cattle guards – UDOT Standard Drawings SW Series
- Signing (Temporary And Permanent)
- Public Information Outreach with rancher associations

Construction

UDOT regional environmental personnel will ensure that all commitments are incorporated into construction projects. If circumstances suggest modifications to the prescribed measures, the region environmental staff and relevant resource agency personnel will meet with the construction staff to review the suggested changes. Regular site visits need to be scheduled for region environmental staff and resource agency staff to ensure proper construction of the crash prevention measures.

Maintenance

The crash prevention measures will require maintenance to ensure that they continue to function. Appropriate maintenance plans for the various measures are developed by UDOT in conjunction with appropriate state agencies. Where possible, monitoring of measures should be performed to determine effectiveness. Accident data should be collected during this phase and analyzed to determine the effectiveness of the measures. These analyses are collected and used to determine appropriate measures for future projects. Crash prevention measure locations and goals should be included in regional maintenance goals. Suggested maintenance activities will be provided by UDOT Environmental division, design engineers, and resource agency staff.

Possible Solutions

- Roadway Maintenance
    - Winter Maintenance (deicing or anti-icing salt mixes)
- Roadside Vegetation Propagation & Maintenance
    - Choice of Reclamation Species
    - Mowing and Clearing of Right of Way

- Carcass Removal
  - Prevent accidents caused by hitting a carcass
  - Prevent scavengers that can become a safety issue

WILDLIFE/VEHICLE ACCIDENT MITIGATION MEASURES

The following mitigation measures are suggested as methods to reduce accidents by improving existing conditions. Wildlife mitigation measures work best when wildlife habitat and their movements are considered during the development and operation of a highway. Generally, WVC occurrences are highest in the evening, night, and early morning hours. To be most effective, mitigation measures should be located at, or near natural wildlife crossing areas.

Proven Counter Measures for Mitigation:

Roadside Vegetation Management (20% reduction):

This option is designed to provide an improved line-of-sight so motorists can better avoid potential conflicts. Vegetation should be cleared at least 10 feet from the edge of the roadway prism. Trees, with diameter of 4 inches or larger, or clumps of trees or shrubs with a combination of 4 inches or greater, should be removed from this cleared area.

Another vegetation management option is to plant vegetation unpalatable to wildlife. This discourages wildlife from wanting to be on the right-of-way. Such plant species can be recommended by wildlife biologists with the Utah Division of Wildlife Resources.

Overpasses (90 to 98% reduction)

Figure 4

Banff National Park in Canada has two overpass structures on the Trans-Canada Highway for wildlife crossing (Figure 4 above). They are landscaped and designed with visual barriers to shield animals from viewing the traffic below which can spook them.

Overpasses can be constructed similar to those in Banff (approximately 100 feet wide throughout), or they can be hourglass shaped, 100 feet wide at the ends and minimally 50 feet wide in the center of the structure.

Underpass Crossings (Bridges):

Figure 5

Bridge underpasses, with natural floor and 2:1 natural side slopes (Figure 5 above), are recommended for nearly all species of wildlife. To be most effective these structures need to be designed for maximum light. The openings need to be large, minimally 8 feet or more high for deer, 12 to 14 feet for elk, and higher for moose.

If the roadway design allows, it is also helpful to daylight the underpass in the center median, with wildlife-proof fencing between structures to prevent animals from entering the traffic lanes. Such fencing should also be constructed back, away from the culvert's openings to allow animals to feel free to brows in the center median and avoid a corral effect that would result if the fence were constructed directly between openings. If there are two or more bridges, underpasses should be designed so they are in line, as opposed to offset or angled, so that animals can see the horizon from both ends.

Placement for elk in high migratory areas can be up to every two miles in high migratory areas. For deer, spacing should be no more than one mile.

Exclusionary right-of-way fencing is also necessary to funnel animals into the structure. Escape ramps should also be included, located at approximately 1/4 to 1/3-mile intervals, and in the four corners of the underpass opening. Vegetation and boulders should also be placed around the entrance to the underpasses to provide cover for animals using the structure.

Underpass Crossings (Box and Steel Arch Culverts):

Figure 6

Figure 7

If properly designed, box culverts (Figure 6) and steel arch culverts (Figure 7) can work well for deer and some small animals. However, until more research is conducted, they are not recommended for elk or moose.

As with bridges, to be most effective these structures need to be designed for maximum light. The openings need to be large, minimally 23 feet wide and 8 feet high for deer, 12 to 14 feet high for elk and higher for moose, in the event a bridge is not an option. Some wildlife underpass experts suggest an opening aspect to length index, calculated as follows:

Width x Height / Length = 0.27 (English units) or larger.

If the roadway design allows, it is also helpful to daylight the underpass in the center median, with wildlife-proof fencing in the opening to prevent animals from entering the traffic lanes. Such fencing should also be constructed back, away from the culvert's openings to allow animals to feel free to brows the center median and avoid a corral effect that would result if the fence were constructed directly between openings. If there are two or more underpasses, they should be designed so they are in line, as opposed to offset or angled, so animals can see the horizon from both ends.

Placement for elk in high migratory areas can be every two miles, for deer, every mile.

Exclusionary right-of-way fencing is also necessary to funnel animals into the structure, with escape ramps located at approximately 1/4-mile intervals and in the four corners of the underpass openings. Vegetation and boulders should also be placed around the entrance to the underpasses to provide cover for animals using the structure.

To evaluate effectiveness of wildlife crossing structures, they need to be monitored using cameras, track pads, etc., both pre- and post-construction. Accident data should also be gathered to determine long-term trends, whether accidents are increasing or decreasing as a result of the new structure. In any individual year, many variables can contribute to changes in accident rates. For instance, if ADT changes, that change could effect the results of the monitoring and should be evaluated as part of the performance measure. If data is available about the health of the herd, it should also be part of the evaluation.

To compare years, or time-periods, the number of carcasses removed should be divided by the ADT. The assumption is that as ADT increases, the numbers of accidents are likely to increase. This comparison can only be used to compare the same stretch of roadway and not to compare different roadways.

Accident data on both sides (1-5 miles) of the proposed structure, or from where the fence extends from the structure, should also be examined pre- and post-construction. This will help to indicate the effectiveness of the structure.

Additionally, each region should establish where each of the routes in their area of responsibility is today with regard to accident numbers, and identify what the future goal is for that section of roadway. The before/after findings should be posted and shared with others using UDOT’s Dashboard.

Exclusionary Fencing – Type-G, 8 feet high (90% to 98% Reduction):

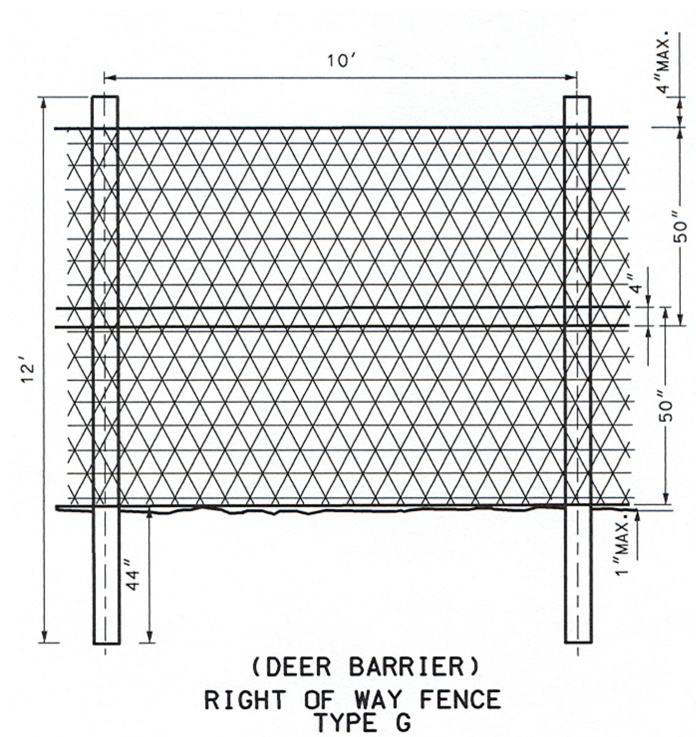


Figure 8

The new Type-G Deer Barrier fence (Figure 8 above), recently approved by UDOT's Standards Committee (see UDOT standard drawings FG series), provides a physical barrier between animals and the roadway. They are most effective when combined with wildlife underpass, or overpass crossings and wildlife escape ramps. Where practicable, fencing should be constructed for at least a mile in both directions of a wildlife under- or overpass, on both sides of the right-of-way. Escape ramps should also be constructed every 1/4 to 1/3 mile to assist wildlife to escape from the right-of-way in the event they breach the fence.

Wildlife Escape Ramps (40% reduction[25]):

Figure 9

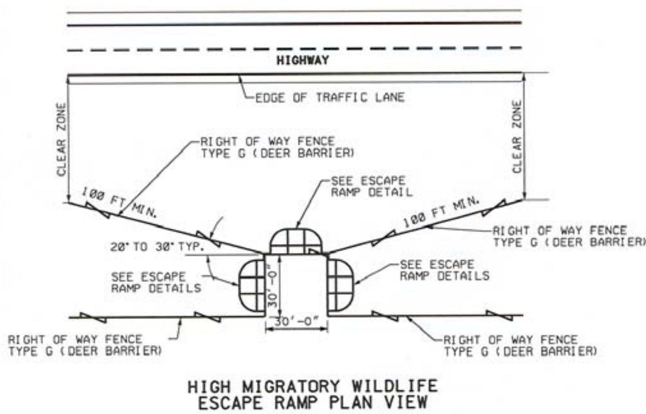


Figure 10

Figure 9, above, shows a typical wildlife escape ramp against the right-of-way fence. Figure 10, above, is a conceptual plan view of a wildlife escape ramp that should be considered in high wildlife migratory areas.

Wildlife Escape Ramps are used to assist wildlife in escaping the right-of-way should they get through the fencing. These structures have been found to be 8 to 11 times more often than one-way deer gates[26]. UDOT has implemented new Standard Drawings for escape ramps; see UDOT Standard Drawings FG Series.

To be most effective, these ramps need to be sited by a qualified wildlife biologist, at between 1/4 to 1/3 mile spacing.

Electrified Fence

There are numerous suppliers of electrified fencing products. Some also include electrified cattle, or wildlife guards. It is not known if any of these products have been used on Utah's highways and freeways to date. The manufacturers indicate they can be of benefit if properly installed, even to the exclusion of deer, elk, and moose. However, more research should be done to determine the effectiveness of these structures on Utah's roadways.

The Arizona Department of Game and Fish have demonstrated that when combined with designed gaps in exclusionary wildlife fencing, electrified wildlife mats or guards can be effective crosswalks that allow animals to safely cross the right-of-way without constructing costly over or underpasses.

Roadway lighting (18% reduction[27])

Approximately ninety-two percent of wildlife accidents happen during the early morning or evening hours[28]. This coincides with the time when animals are foraging, and need to cross highways for water and feed.

Evening hours are also the time when visibility is lowest. Urban highway lighting can help to reduce these accidents by making animals more visible.

Reduction in posted speed limit

Reducing the speed limit can increase drivers' time to see and avoid collisions with wild animals. Reductions can be seasonal, when animals are migrating. This is especially effective when accompanied by flashing signs, warning motorists of wildlife migrating across the highway.

Wildlife Warning Signs (probably ineffective)

Figure 11

Figure 12

Ordinary deer warning signs as depicted in Figure 11 above have been found to be mostly ineffective. Motorists tend to become accustomed to the signs, and upon seeing no immediate danger, ignore them.

Seasonal use of flashers with warning signs during migration seasons, as depicted in Figure 12 may be more effective. By installing flashers on deer crossing signs during the spring and fall, when the highest numbers of animal-vehicle collisions occur, drivers tend to pay closer attention. The key to this strategy is to narrow the amount of "exposure" time of the flashing signs. The longer the flashers remain in place the less effective they prove to be as drivers become habituated to seeing them. Therefore, it is important that the time-periods be clearly identified prior to using the flashers. This can be done through a detailed query of the Crash Data Almanac System for a particular state route.

Roadside Animal Detection Systems (82% reduction)

Figure 13 Photo courtesy Marcel Huijser

Figure 14 Photo Courtesy Alan Dibb

According to Huijser, et. al, roadside animal detection systems can use sensors to detect large animals that approach the road. When a large animal is detected, the sensors send a message to a warning signal, usually lights mounted on signs (see figures 13 and 14 above) to inform motorists that a large animal is currently on or near the road. When a driver becomes aware that an animal may be on or near the road ahead, he/she may become more alert, may reduce vehicle speed, or both.[29] These systems can also relay a message to variable message boards (see Figure 15 below) or even to a televised view of the animal on the right-of-way.

Figure 15 **Photo Courtesy Angela Kociolek**

Public information and education
Public awareness can be a major factor in reducing wildlife/vehicle accidents. If the travelling public is aware of wildlife migration taking place along a particular route or location, they will be better prepared to avoid conflicts. The news media, both television and radio, is probably the best avenue of disseminating this information. However, newspaper articles can also help alert the public.

Hunting and Herd Reduction
Herd reduction through normally scheduled hunting seasons, or even through special hunts specifically designed to reduce herd numbers, can help reduce accidents. However, in Utah, many deer herds are already at low levels, often due to WVCs.

Communication/Coordination with other resource agencies.
Continuing communication and coordination with natural resource agencies, especially the Utah Division of Wildlife Resources (UDWR), is important when designing measures to prevent animals from getting on rights-of-way. UDWR personnel are usually a knowledgeable resource.

Policies/Standards – Must account for costs and benefits.
- Maintenance
  - Winter maintenance of crossing structures, fences, and wildlife escape ramps.

  - Integrated roadside vegetation management plan including vegetation propagation, clearing, mowing, etc.
  - Timely Carcass Removal, including GPS location, date, and species.

- Design:
  - Posted reduced speed limits
  - Increasing radius of curves
  - Wider shoulder, right of way, increased clear zone, etc.) with narrower lane width
  - Bridge height, width, and length adequate for wildlife use
- Planning
  - Roadway planning and alignment located to avoid wildlife conflicts where possible

Other Methods of Unproven Success:

The following technologies have been suggested as being helpful. However, there is little evidence of their practicality or ability to prevent accidents.

In-Vehicle Technologies – Animal Sensing Devices and In-Vehicle Displays

- Not tested thoroughly
- Can give false readings
- Potential for Problems with Driver Compliancy
- Information Overload/Distraction
- High cost

Deer Whistles

- Questionable Scientific Evidence of Effectiveness
- Deer May Not be Able to Hear Whistles

Roadside Reflectors and Mirrors

- No Conclusive Study Showing Effectiveness
- High Installation Cost
- High Maintenance/Cleaning Cost

Designated Deer Crosswalks

- Minimal Evidence of Reduced Road Kill After Installation
- Animals get on ROW Regardless

DOMESTIC ANIMAL ACCIDENT MITIGATION MEASURES

Many of the mitigating measures used for wildlife can also help reduce domestic animal accidents. The following are some additional measures known to be useful.

Fencing – replace/repair/construct

For domestic animals, fencing is probably the most effective measure of preventing animals from entering the right-of-way. Many fences alongside the right-of-way are in disrepair allowing livestock to get onto highways. Fencing needs to be maintained to UDOT right-of-way fence standards to be effective. Where it is the responsibility of land owners to maintain the fences, UDOT should encourage them to keep the fences up to standards.

Electrified Fence

Electrified fences are often used by ranchers and property owners to keep livestock penned in. To be effective, the fences need to be maintained, with warning signs to prevent human injury.

Signing – Temporary or Permanent

As mentioned above, drivers can become habituated to permanent warning signs. Temporary signs, or those having flashing lights, can work when livestock are known to be on the right-of-way, especially in open range areas.

Cattle Guards, see UDOT Standard Drawings SW Series

When combined with livestock fencing, cattle guards can be an effective tool to use in places where gates are likely to be left open. However, UDOT maintenance crews prefer not to use cattleguards due to problems with snowplows getting hung up. Where UDOT does not have maintenance responsibility, cattleguards should be encouraged to help keep livestock off the highways.

Mitigation Measures for Further Research:

- Roadway Lighting
- Speed Limit Reduction
- Deicing Salt Alternatives (may attract deer to the roadside)
- Deer Crossing Signs And Technologies
  - Typical deer symbol crossing warning signs
  - Lighted “DEER XING” signs
  - Animated deer crossing signs
  - Utah primary and secondary temporary deer crossing sign designs
  - Michigan temporary deer crossing sign design
  - Dynamic elk sign and sensor system
  - Infrared, laser, and camera activated animal sensors
- Repellents
  - Chemical
  - Biological

- Public Information And Education
  - http://www.deercrash.com/releases.htm
  - http://www.dps.state.ia.us/deercrashes/
  - http://www.state.me.us/mdot/safety-programs/maine-crash-data.php
  - http://www.semcog.org/TranPlan/TrafficSafety/MDCC/index.htm

MITIGATION MEASURES EMPLOYED IN UTAH

Lessons Learned From Crossings South of Beaver

For this report, Michelle Page contacted Area Supervisor, Ree Schena, and the Beaver Station Supervisor, Doug Beeson, to obtain their thoughts on the over/under passes installed on Interstate 15, south of Beaver, in 1988.

Summary

1) Deer, not elk, use the Beaver overpasses
2) Underpasses are good for deer and elk. (if they are properly designed, simple span structures)
3) Need to monitor existing wildlife passages such as underpasses and the overpasses near Beaver. It will be difficult to select potential remedies without more details about successes, failures, and needed improvements.
4) One of the existing underpasses, north of the overpasses, made use of an existing drainage and frontage road. It is in a good natural crossing location.
5) The existing underpasses work well because they are wide open, have daylight, and appear natural.
6) One underpass has a Frontage Road that somewhat impedes wildlife crossings.
7) Suggest driving cattle through any new underpasses to make a trail for deer to follow.
8) Without the existing overpasses and underpasses, current traffic volume on I-15 south of Beaver would make wildlife crossing difficult, especially at night.
9) Animals are hesitant to use the overpass because it is narrow. (Overpass could also be improved with landscaping that is similar to the surrounding environment and blinds that block the highway from the animals' view and noise. (This should be coordinated with the UDOT wildlife biologist and the region landscape architects.)
10) After 17+ years the deer have accepted the underpasses as their migration route.
11) After installation of crossings, there was a significant drop in deer kills, now only 1 to 2 per year. Prior to that, there was a high number of kills.
12) Old UDOT Standard for one-way escape gates was not effective. Gates were blocked because animals often go the wrong way into the ROW.

Lessons Learned from U.S. 6

Initially, when using UDOT Traffic & Safety's Crash Data Almanac, US 6 had no reported wildlife vehicle collision "hot spots". However, after sending this toolkit report out for review, the Utah Division of Wildlife Resources (UDWR) forwarded comments from the Draft U.S. 6 Reconstruction EIS, that provided wildlife-vehicle collision totals that were of much greater magnitude than indicated by UDOT's Traffic and Safety (T/S) records. The T/S numbers showed 77 hits per year between milepost 177 and 234. However, UDWR reported 590 hits per year between milepost 174 and 270, a nearly eight-fold increase. After further investigation, this QIT realized that the UDWR numbers were much more realistic. The difference was accounted for by large tractor-trailer trucks hitting wildlife, but not stopping or reporting them. The UDOT Maintenance Area Supervisors in Regions Three and Four (Price District) verified this information, based on carcass removal data.

Other Lessons Learned In Utah

Deer Gates

Only 16% of the deer that approached the one-way gates installed in Summit County actually used them. Therefore, it was determined that the gates were not effective.

Reflectors

On U.S. 6 (Helper to Price) and on I-80 (Wanship to Coalville) wildlife reflectors were installed. These were intended to startle deer off the roadway when a vehicle approached at night. The headlights were supposed to connect with the lens of the reflector, and reflect a beam that deer could see which would frighten them away. Spacing of the reflectors varied from 25 to 50 feet depending on the tangent or curve of the roadway. At the time of these test sections, the reflectors were $27.50 each, attached to a new delineator post at $12.50 each.

Test results indicated that there were no reductions in the number of deer-vehicle collisions due to these reflectors. Maintenance crews actually reported an increase in deer kills. It appeared to the maintenance crews that the deer would become trapped between reflectors, possibly being attracted to the lights. There was also a question regarding whether the reflectors can work with mule deer, as they were designed for whitetail deer.

Maintenance personnel also noted, that once the lens became dirty with slushy snow and mud, they no longer reflected. This was very frustrating for the maintenance crews assigned to these test sections, as they had other tasks of higher priority. Other test sections were tried with similar results. In the end, the use of reflectors was not recommended as an effective means for reducing deer-vehicle collisions.

Crosswalks

For a research project, UDOT installed painted crosswalks on U.S. 40 and SR-248 in Summit and Wasatch Counties. These were painted to simulate cattle guards. Riprap was used to border dirt-crossing trails that connected to openings in the deer fence.

In the first three months following installation, three deer were observed attempting to use the crosswalks. All three wandered outside the "confines" of the crosswalk and onto the right-of-way. Six subsequent crossings were observed where the deer remained within the “confines” of the crosswalk and cars hit two of these animals. Therefore, it was determined that the crosswalks were ineffective.

POLICIES & STANDARDS

A UDOT policy that considers the planning, project development, and operational aspects of wildlife and domestic hot spots should be developed and implemented. The policy should include a determination of benefit/cost, “Hot Spot” definition, location, and prioritization, project identification, environmental coordination, design, construction responsibility, maintenance responsibility, mitigation measures, funding, and performance measures.

UDOT Standard Drawings and Specifications needs to be continually reviewed to incorporate the most up to date methods for reducing wildlife and domestic animal/vehicle accidents.

COMMUNICATION/COORDINATION

Collaboration with stakeholders provides opportunities to address wildlife and domestic animal concerns associated with transportation facilities. Many channels of communication already exist, such as coordination with the US Fish and Wildlife Service (US FWS), Federal Highway Administration (FHWA), Utah Division of Wildlife Resources (UDWR), UDOT Maintenance, and property owners adjacent to our right of way, on a project-by-project basis. A general Memorandum of Understanding (MOU) between UDOT and UDWR was written in 2003 which recognizes the importance of collaboration on transportation, and associated wildlife impacts and mitigation.

In addition to the key state and federal resource agencies, communication and coordination with other stakeholder agencies such as Environmental Protection Agency (EPA), U.S. Army Corp of Engineers (USACE), State Institutional Trust Lands Administration (SITLA), U.S. Forest Service (US FS), Bureau of Land Management (BLM), and Non-Government Organizations (NGOs), may also be beneficial. In addition, individual involvement with farmers/ranchers, concerned citizens, researchers, wildlife experts, UDOT regional and central environmental staff should also be consulted.

INFORMATIONAL WEBSITES

- FHWA Critter Crossing: http://www.tfhrc.gov/pubrds/marapr00/critters.htm
- AASHTO Center for Environmental Excellence: http://environment.transportation.org/
- ICOET (International Conference on Ecology and Transportation): www.itre.ncsu.edu/cte/icoet/html
- Wildlife Studies in Utah by Utah State University: http://www.cnr.usu.edu/faculty/jbissonette/index.htm

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Northeastern Region (Contact for UDOT Region 3)

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Habitat Manager	Bruce Bonebrake	(435) 865-6100

Southeastern Region (Contact for UDOT Region 4)

475 West Price River Drive, Suite C
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Habitat Manager	Chris Wood	(435) 636-0260

U.S. Fish and Wildlife Service

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West Valley City, UT 84119
(801) 975-3330

Field Supervisor	Larry Crist	(801) 975-3330

Threatened & Endangered Species Coordinator:

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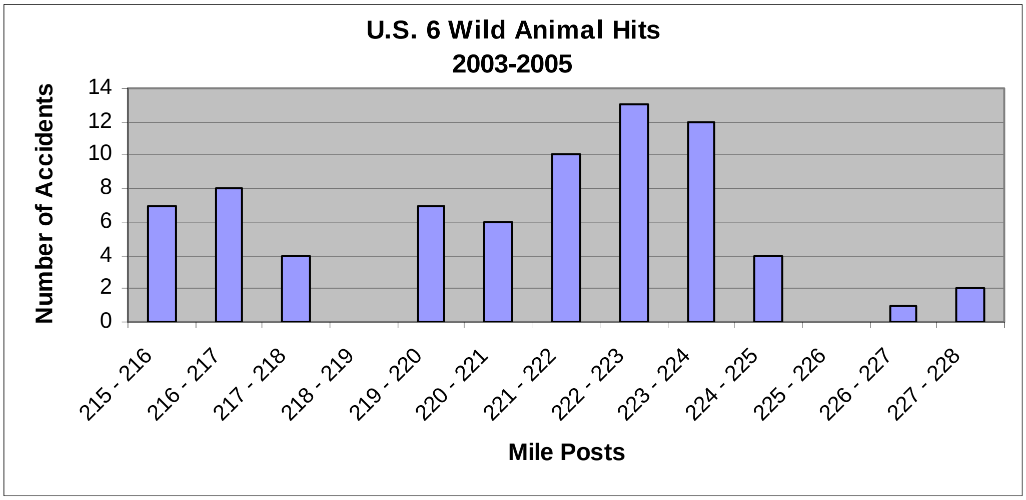
FUNDING SOURCES

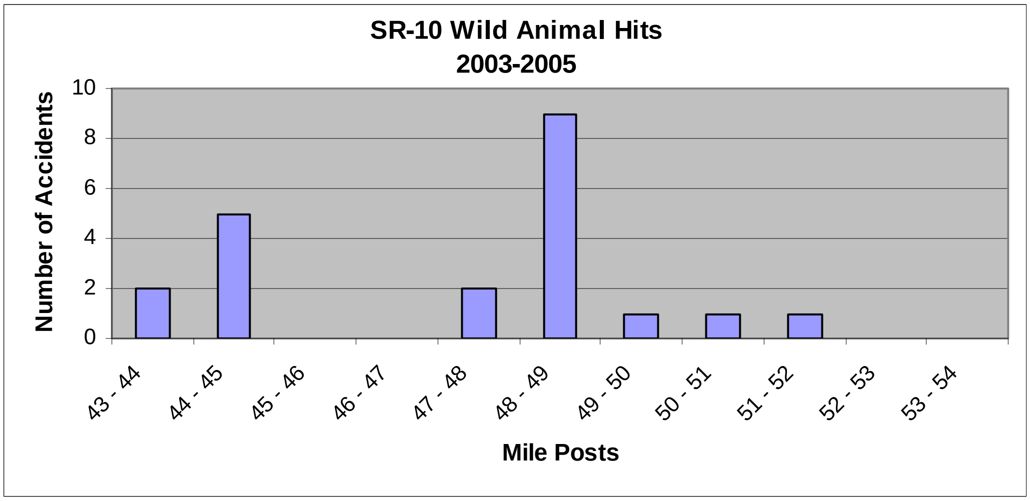
Following is a list of potential sources of funding partnerships for wildlife mitigation measures. Many of these organizations or agencies have a vested interest in preserving wildlife for sport or conservation reasons. These groups should be contacted by the UDOT Project Manager or region planners to cooperate with UDOT in the construction of major wildlife projects.

- Utah Division of Wildlife Resources, Dedicated Hunter Program
- Utah Division of Wildlife Resources, Habitat Managers
- Code 1 Maintenance
- 3R Projects
- UDOT Reconstruction Projects
- UDOT Safety Spot Improvements
- UDOT Maintenance Spot Improvements
- Hazard Elimination Safety
- UDOT Transportation Enhancement
- UDOT High Priority Projects/Demonstration Projects
- UDOT Highway Research
- Priority Technology
- UDOT Roadside Vegetation Plan
- USFS & BLM Mitigation Funds
- FHWA Technology Transfer Funds
- FHWA Environmental Streamlining Funds
- Utah Mule Deer Foundation
- Rocky Mountain Elk Foundation

APPENDIX A

Wild Animal Accidents


U.S. 6 Wild Animal Hits
2003-2005
Number of Accidents
0
2
4
6
8
10
12
14
215 - 216
216 - 217
217 - 218
218 - 219
219 - 220
220 - 221
221 - 222
222 - 223
223 - 224
224 - 225
225 - 226
226 - 227
227 - 228
Mile Posts


SR-10 Wild Animal Hits
2003-2005
Number of Accidents
0
2
4
6
8
10
43 - 44
44 - 45
45 - 46
46 - 47
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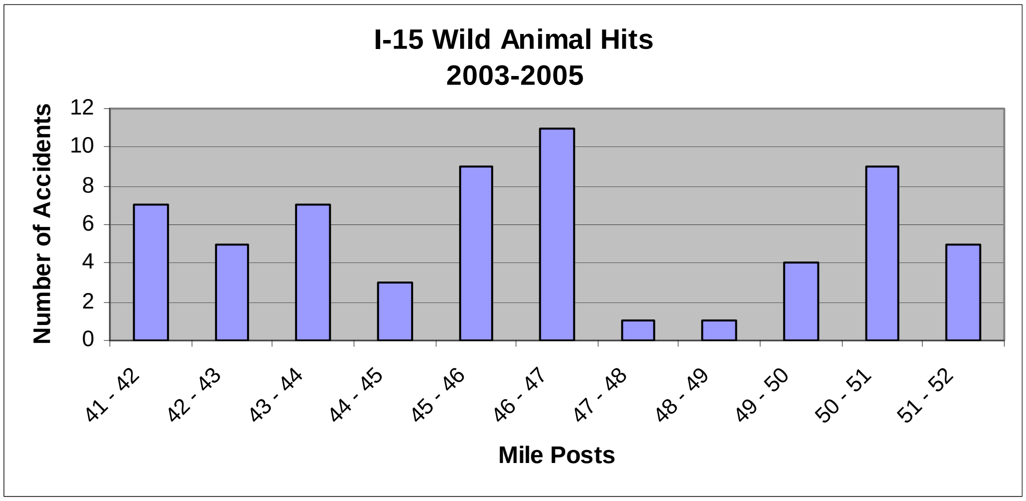
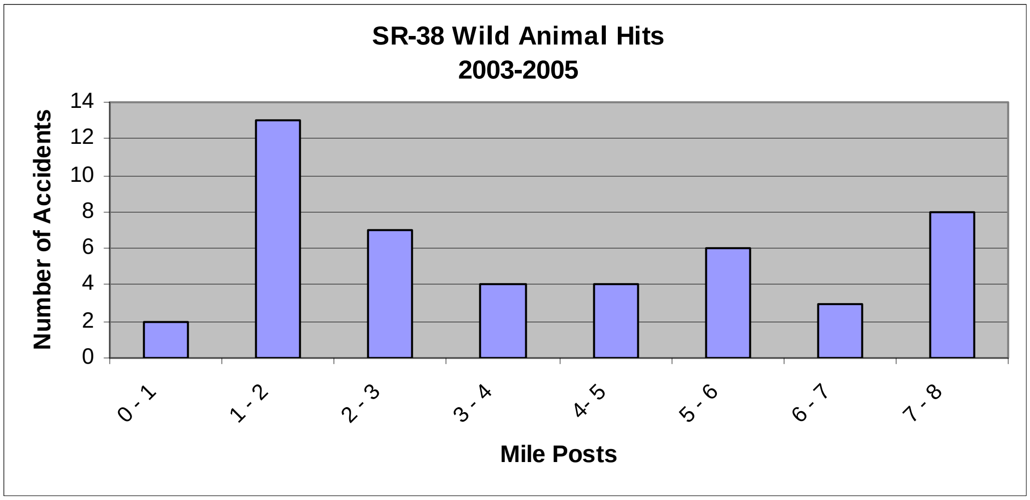
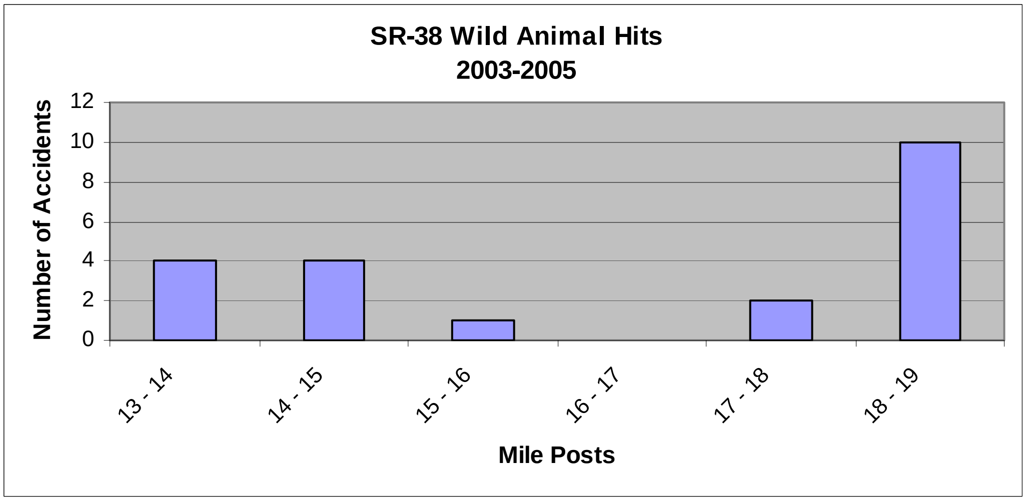
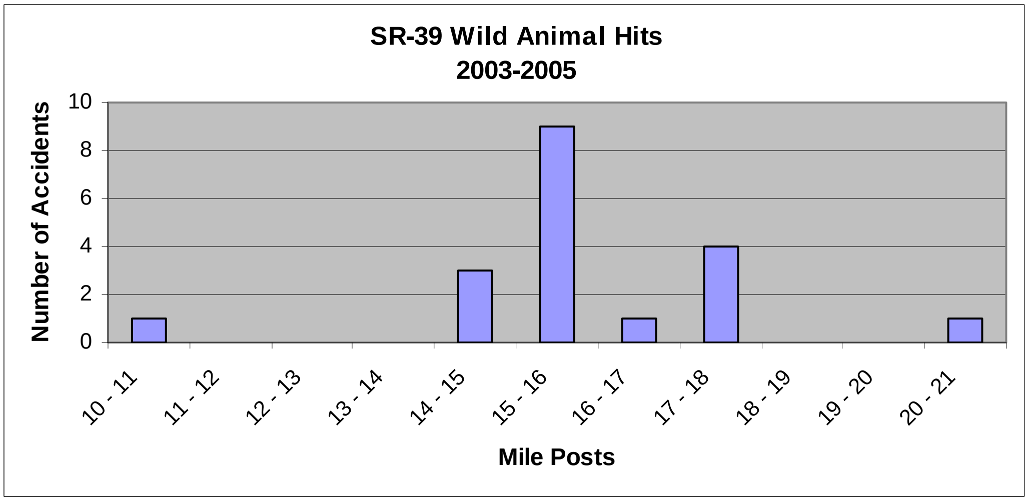
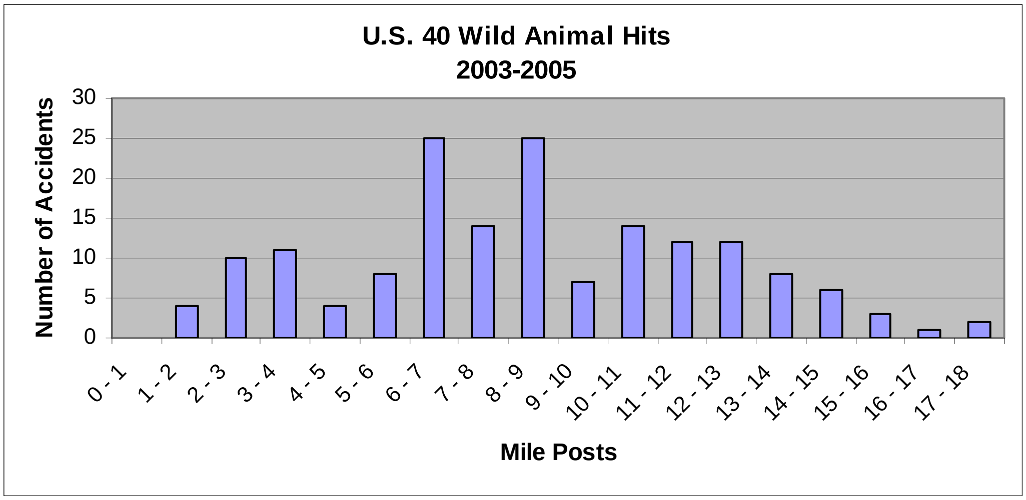
52 - 53
53 - 54
Mile Posts

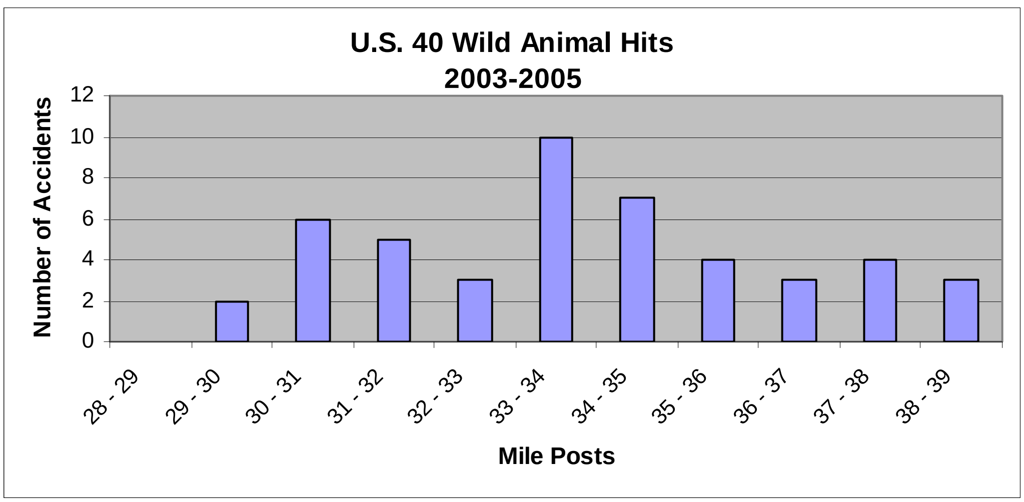

I-15 Wild Animal Hits
2003-2005
Number of Accidents
0
2
4
6
8
10
12
41 - 42
42 - 43
43 - 44
44 - 45
45 - 46
46 - 47
47 - 48
48 - 49
49 - 50
50 - 51
51 - 52
Mile Posts

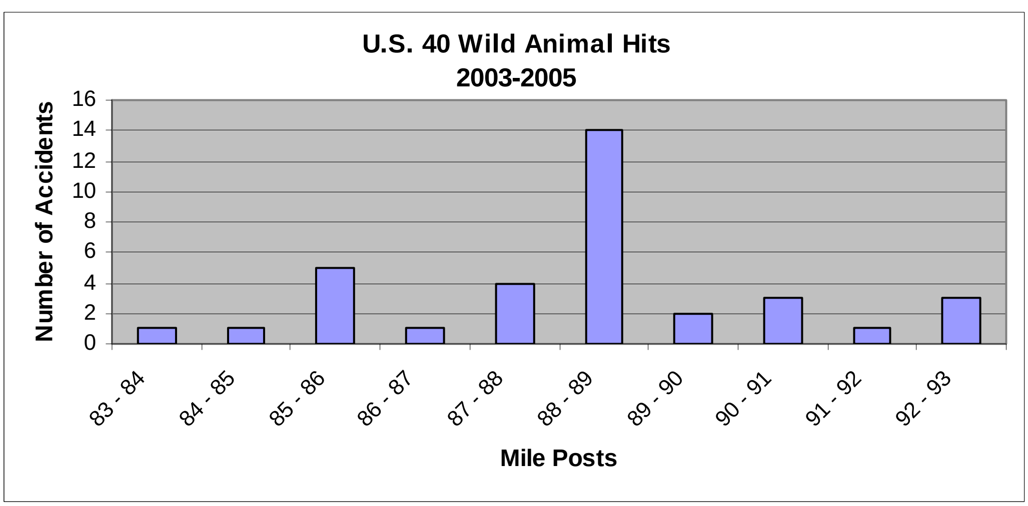

SR-38 Wild Animal Hits
2003-2005
Number of Accidents
14
12
10
8
6
4
2
0
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Mile Posts

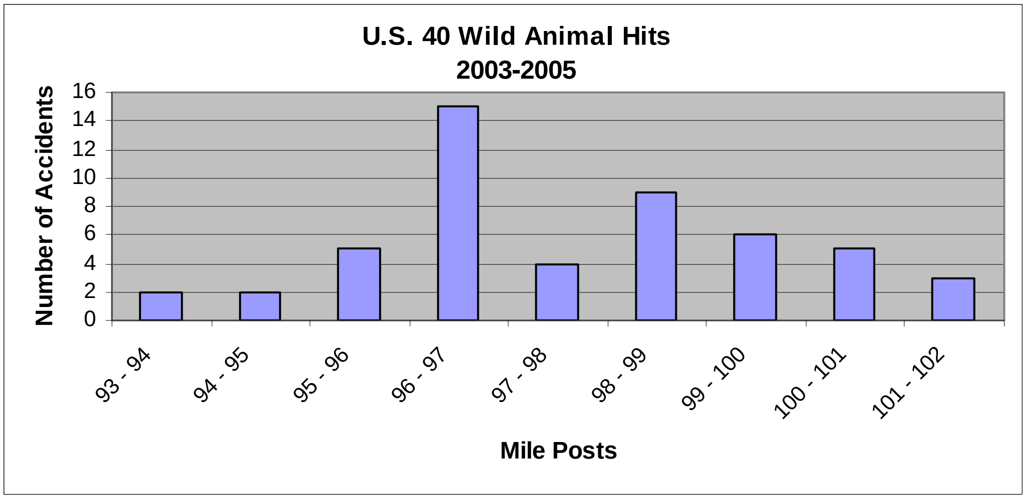

SR-38 Wild Animal Hits
2003-2005
Number of Accidents
12
10
8
6
4
2
0
13 - 14
14 - 15
15 - 16
16 - 17
17 - 18
18 - 19
Mile Posts

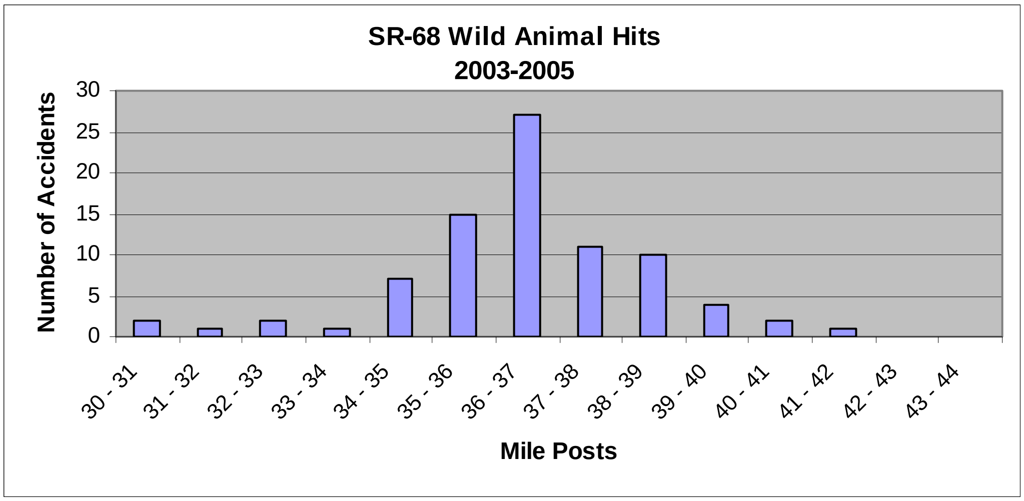

SR-39 Wild Animal Hits
2003-2005
Number of Accidents
10
8
6
4
2
0
10 - 11
11 - 12
12 - 13
13 - 14
14 - 15
15 - 16
16 - 17
17 - 18
18 - 19
19 - 20
20 - 21
Mile Posts

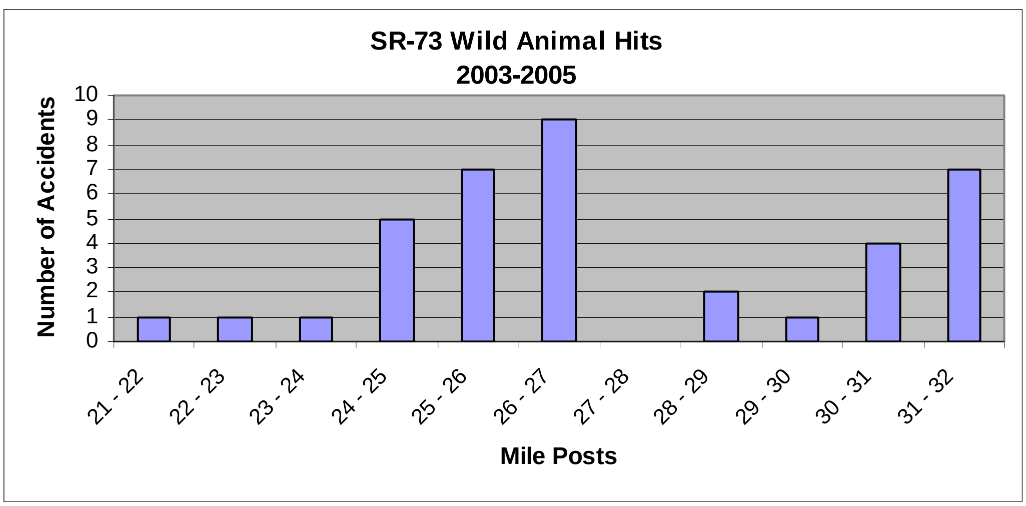

U.S. 40 Wild Animal Hits
2003-2005
Number of Accidents
30
25
20
15
10
5
0
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
11 - 12
12 - 13
13 - 14
14 - 15
15 - 16
16 - 17
17 - 18
Mile Posts

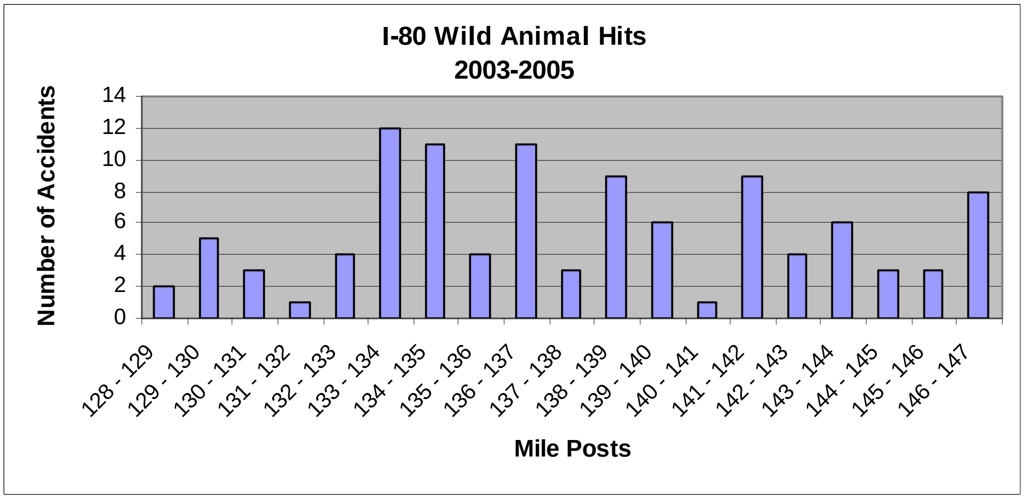

U.S. 40 Wild Animal Hits
2003-2005
Number of Accidents
12
10
8
6
4
2
0
28 - 29
29 - 30
30 - 31
31 - 32
32 - 33
33 - 34
34 - 35
35 - 36
36 - 37
37 - 38
38 - 39
Mile Posts

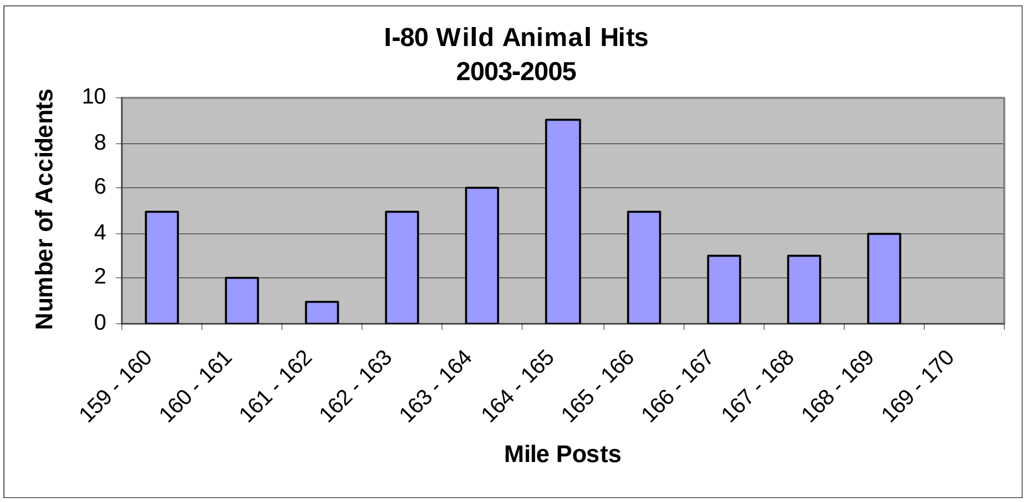

U.S. 40 Wild Animal Hits
2003-2005
Number of Accidents
16
14
12
10
8
6
4
2
0
83 - 84
84 - 85
85 - 86
86 - 87
87 - 88
88 - 89
89 - 90
90 - 91
91 - 92
92 - 93
Mile Posts

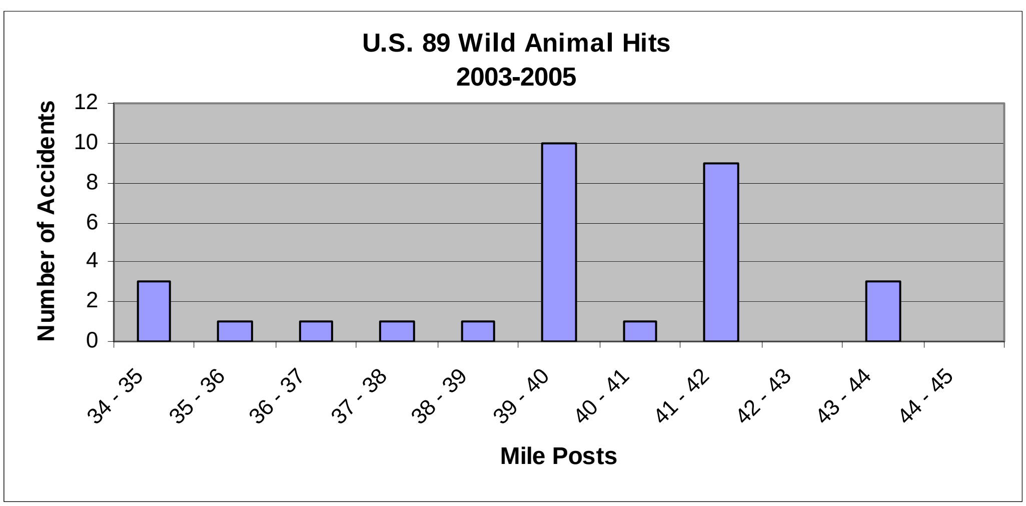

U.S. 40 Wild Animal Hits
2003-2005
Number of Accidents
0
2
4
6
8
10
12
14
16
93 - 94
94 - 95
95 - 96
96 - 97
97 - 98
98 - 99
99 - 100
100 - 101
101 - 102
Mile Posts

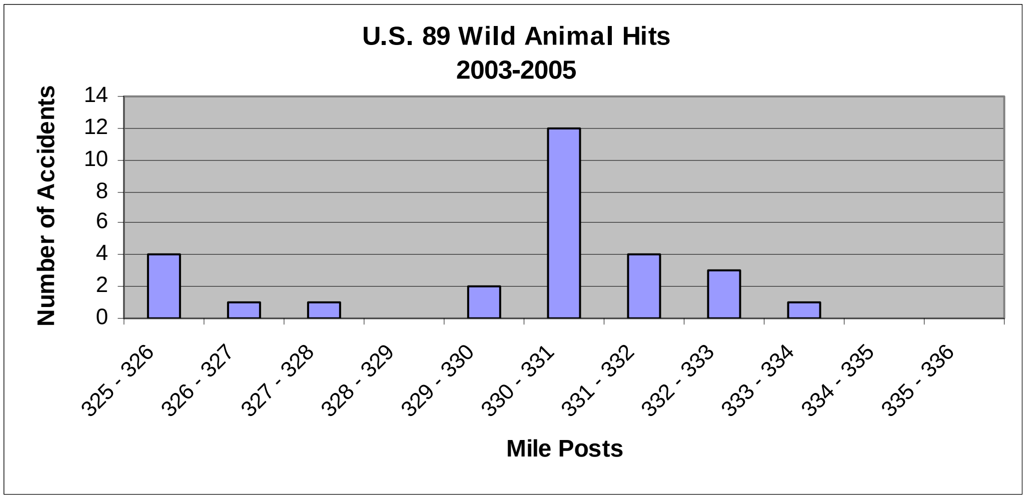

SR-68 Wild Animal Hits
2003-2005
Number of Accidents
0
5
10
15
20
25
30
30 - 31
31 - 32
32 - 33
33 - 34
34 - 35
35 - 36
36 - 37
37 - 38
38 - 39
39 - 40
40 - 41
41 - 42
42 - 43
43 - 44
Mile Posts

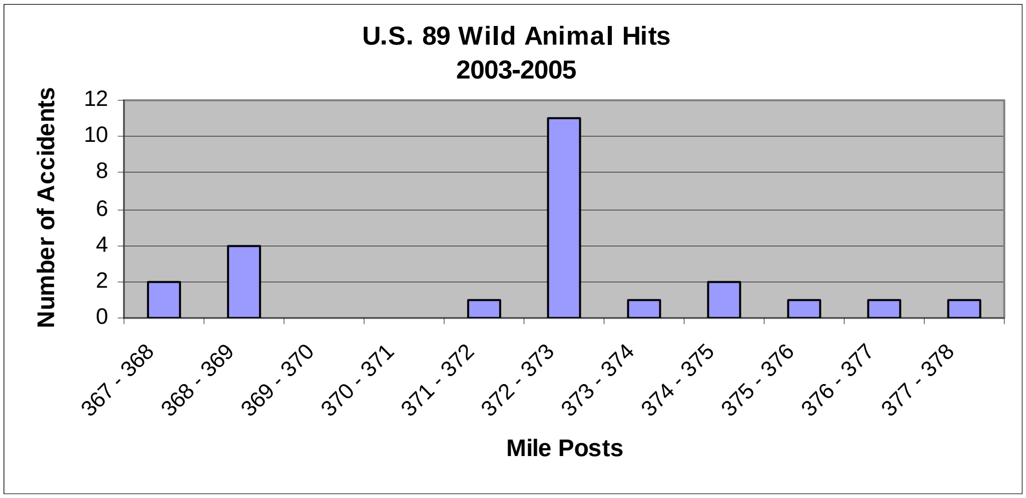

SR-73 Wild Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
5
6
7
8
9
10
21 - 22
22 - 23
23 - 24
24 - 25
25 - 26
26 - 27
27 - 28
28 - 29
29 - 30
30 - 31
31 - 32
Mile Posts

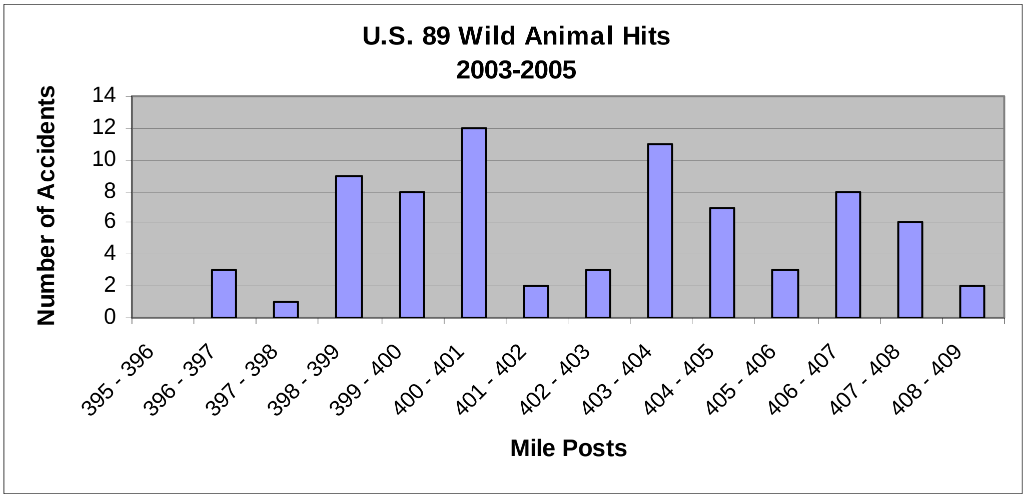

I-80 Wild Animal Hits
2003-2005
Number of Accidents
Mile Posts
128 - 129
129 - 130
130 - 131
131 - 132
132 - 133
133 - 134
134 - 135
135 - 136
136 - 137
137 - 138
138 - 139
139 - 140
140 - 141
141 - 142
142 - 143
143 - 144
144 - 145
145 - 146
146 - 147

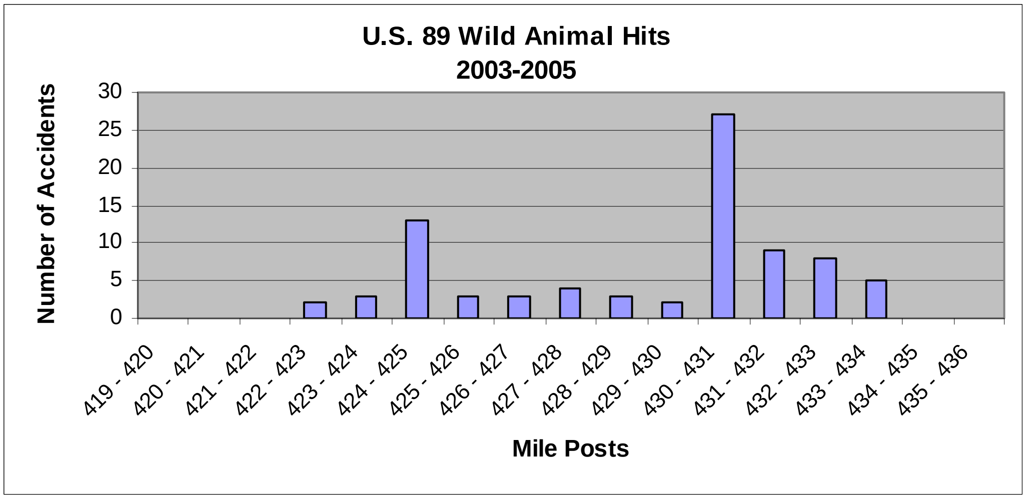

I-80 Wild Animal Hits
2003-2005
Number of Accidents
Mile Posts
159 - 160
160 - 161
161 - 162
162 - 163
163 - 164
164 - 165
165 - 166
166 - 167
167 - 168
168 - 169
169 - 170

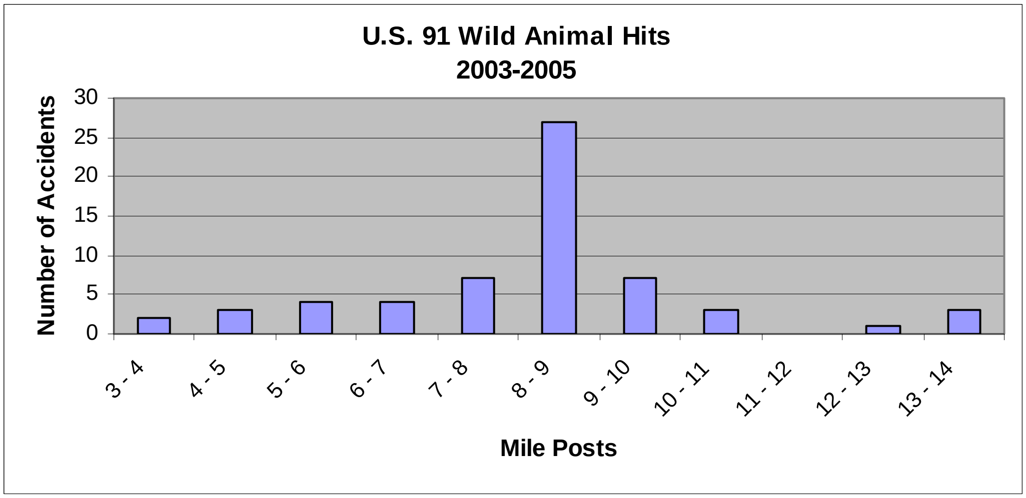

U.S. 89 Wild Animal Hits
2003-2005
Number of Accidents
Mile Posts
34 - 35
35 - 36
36 - 37
37 - 38
38 - 39
39 - 40
40 - 41
41 - 42
42 - 43
43 - 44
44 - 45

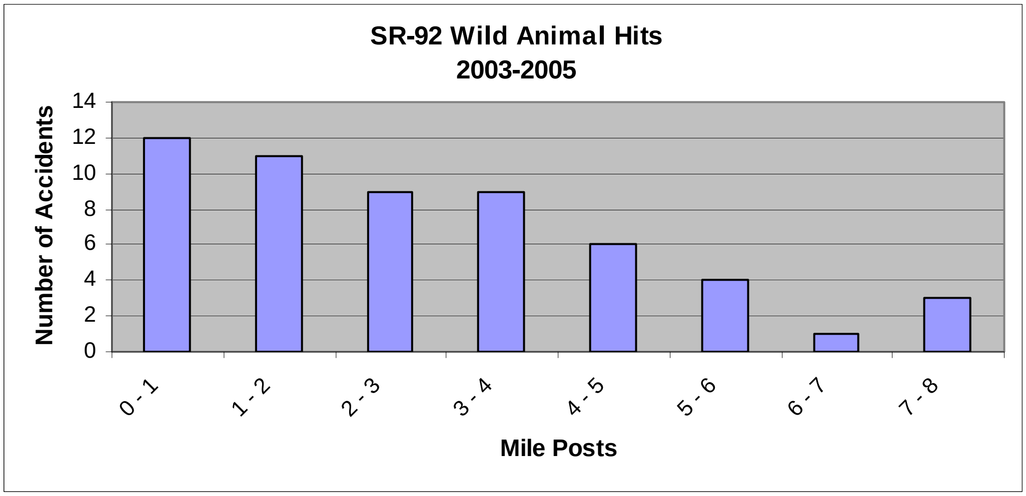

U.S. 89 Wild Animal Hits
2003-2005
Number of Accidents
14
12
10
8
6
4
2
0
325 - 326
326 - 327
327 - 328
328 - 329
329 - 330
330 - 331
331 - 332
332 - 333
333 - 334
334 - 335
335 - 336
Mile Posts

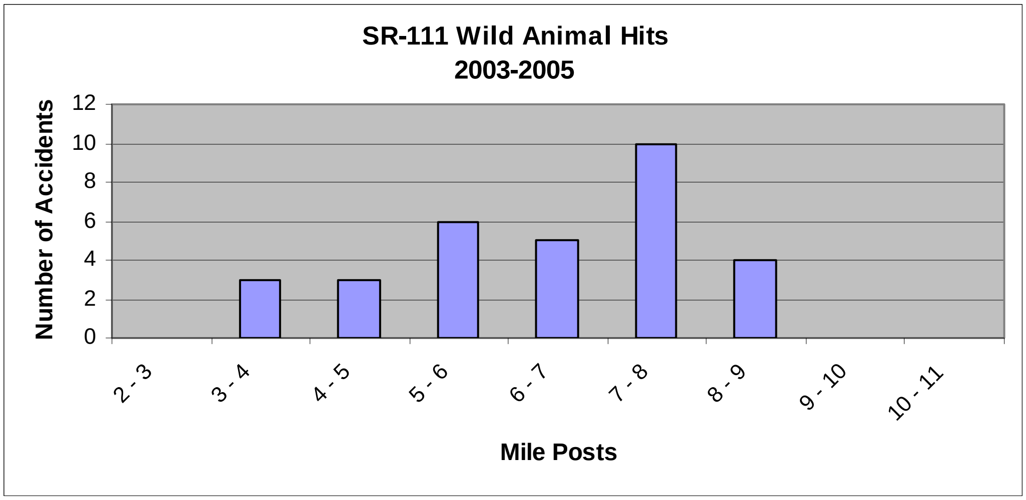

U.S. 89 Wild Animal Hits
2003-2005
Number of Accidents
12
10
8
6
4
2
0
367 - 368
368 - 369
369 - 370
370 - 371
371 - 372
372 - 373
373 - 374
374 - 375
375 - 376
376 - 377
377 - 378
Mile Posts

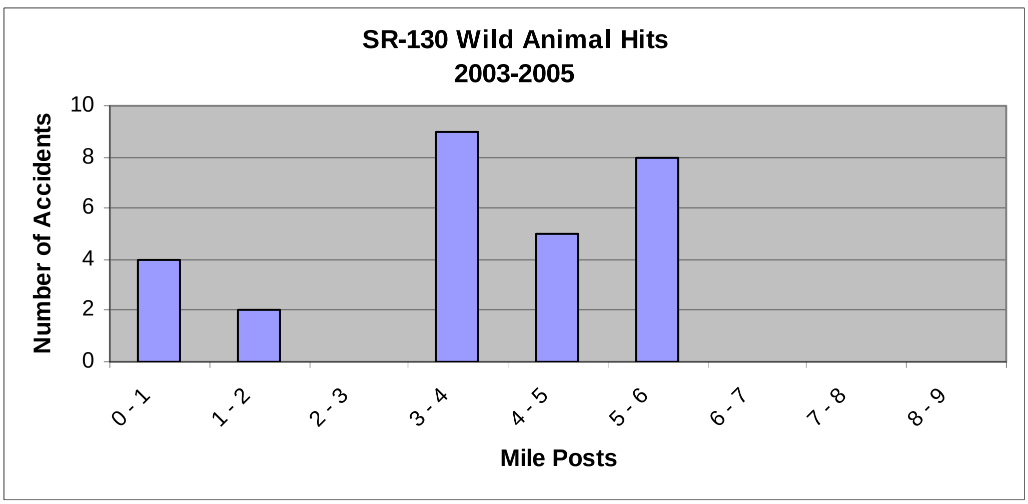

U.S. 89 Wild Animal Hits
2003-2005
Number of Accidents
14
12
10
8
6
4
2
0
395 - 396
396 - 397
397 - 398
398 - 399
399 - 400
400 - 401
401 - 402
402 - 403
403 - 404
404 - 405
405 - 406
406 - 407
407 - 408
408 - 409
Mile Posts

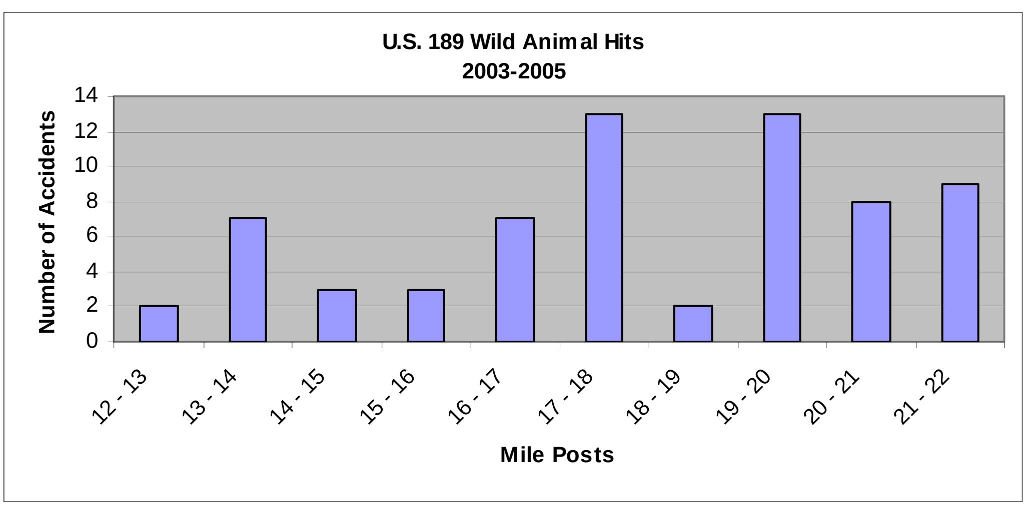

U.S. 89 Wild Animal Hits
2003-2005
Number of Accidents
30
25
20
15
10
5
0
419 - 420
420 - 421
421 - 422
422 - 423
423 - 424
424 - 425
425 - 426
426 - 427
427 - 428
428 - 429
429 - 430
430 - 431
431 - 432
432 - 433
433 - 434
434 - 435
435 - 436
Mile Posts

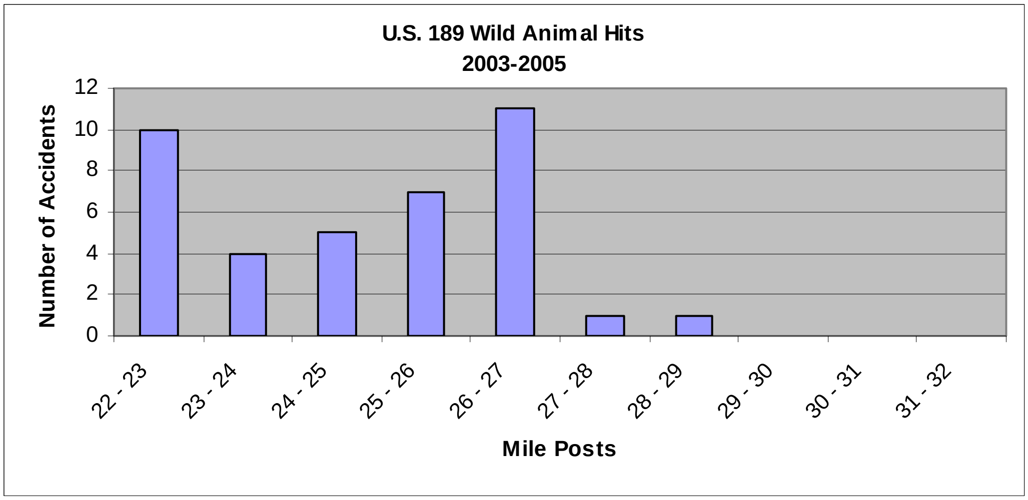

U.S. 91 Wild Animal Hits
2003-2005
Number of Accidents
30
25
20
15
10
5
0
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
11 - 12
12 - 13
13 - 14
Mile Posts

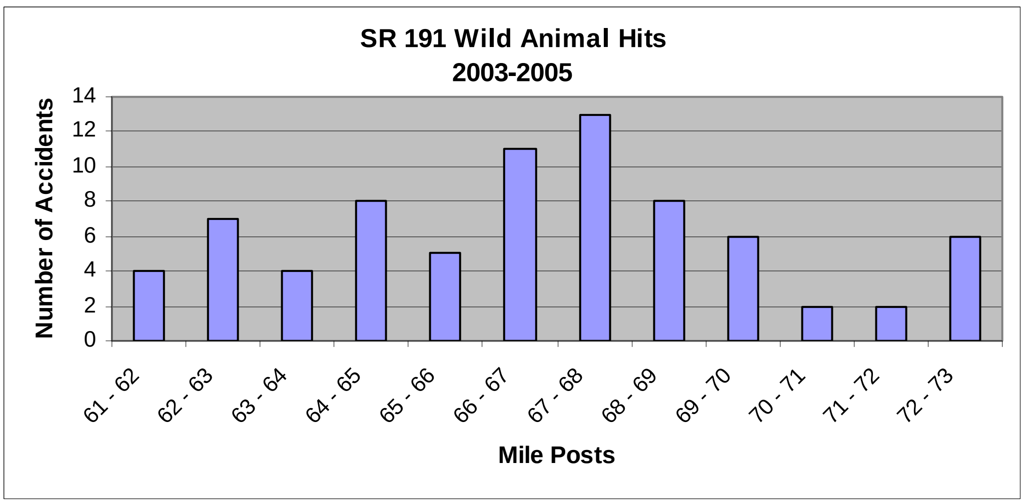

SR-92 Wild Animal Hits
2003-2005
Number of Accidents
14
12
10
8
6
4
2
0
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Mile Posts

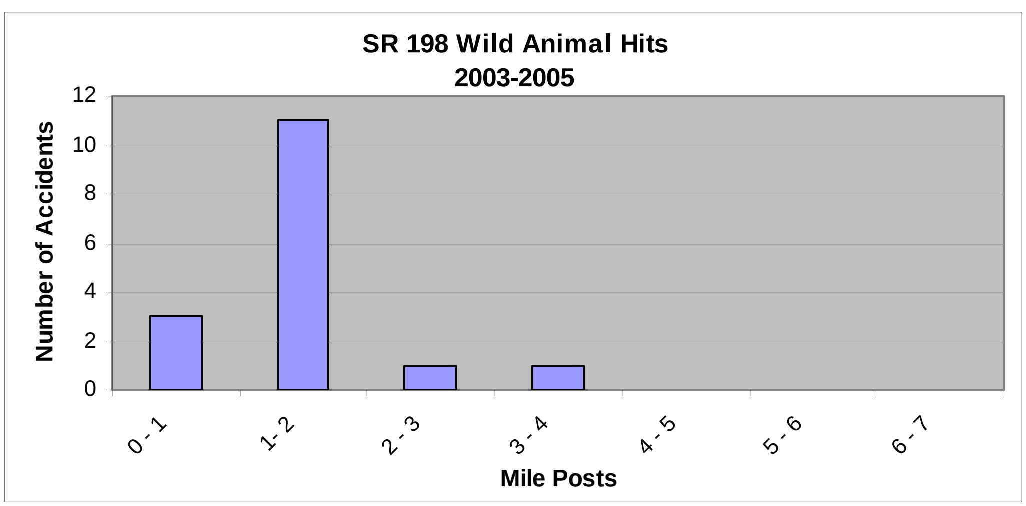

SR-111 Wild Animal Hits
2003-2005
Number of Accidents
12
10
8
6
4
2
0
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
Mile Posts

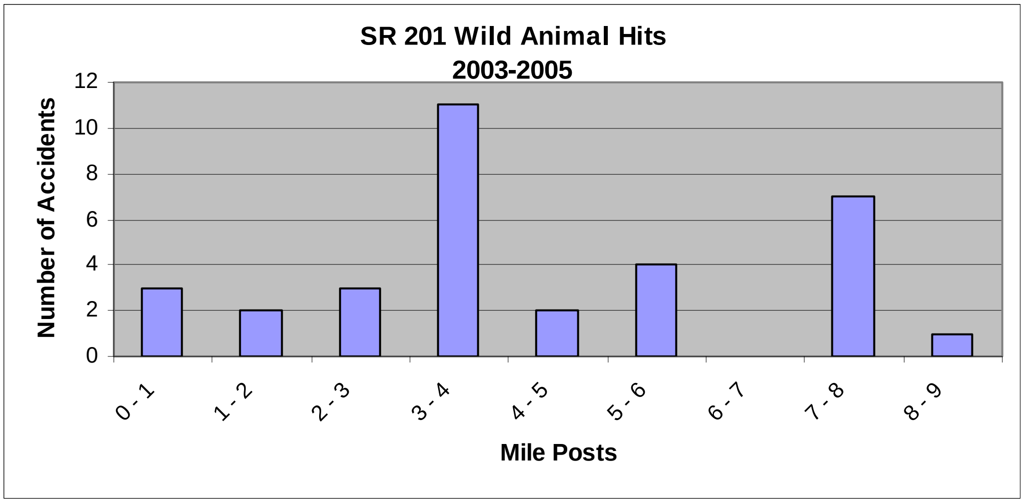

SR-130 Wild Animal Hits
2003-2005
Number of Accidents
10
8
6
4
2
0
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
Mile Posts

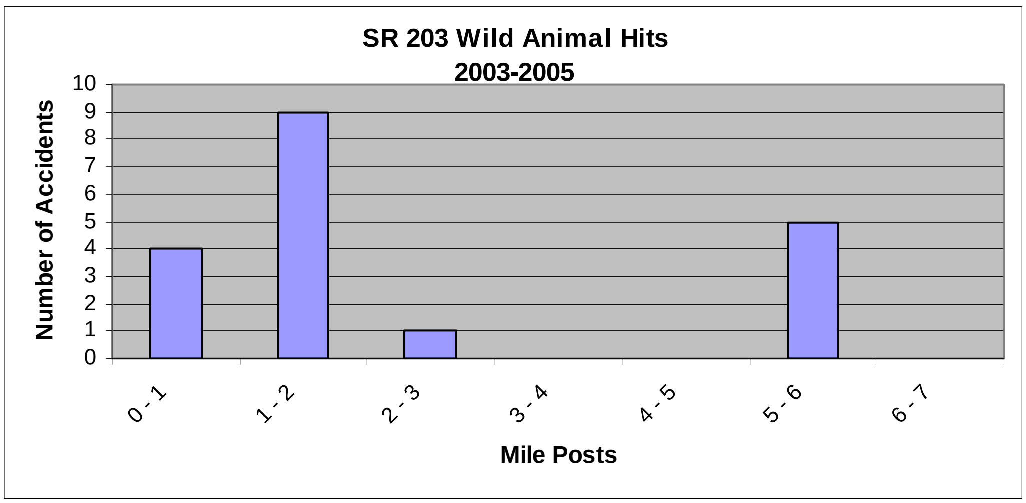

U.S. 189 Wild Animal Hits
2003-2005
Number of Accidents
14
12
10
8
6
4
2
0
12 - 13
13 - 14
14 - 15
15 - 16
16 - 17
17 - 18
18 - 19
19 - 20
20 - 21
21 - 22
Mile Posts

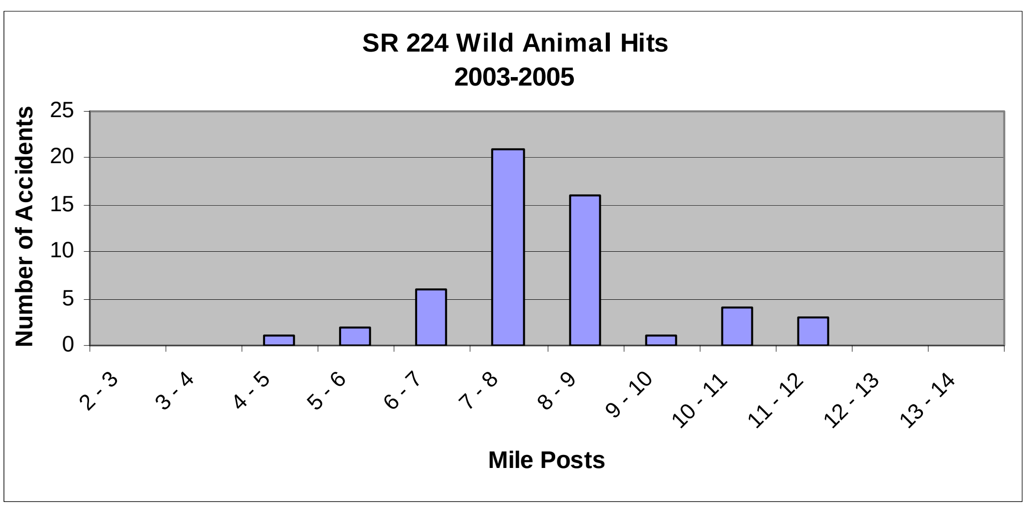

U.S. 189 Wild Animal Hits
2003-2005
Number of Accidents
0
2
4
6
8
10
12
22 - 23
23 - 24
24 - 25
25 - 26
26 - 27
27 - 28
28 - 29
29 - 30
30 - 31
31 - 32
Mile Posts


SR 191 Wild Animal Hits
2003-2005
Number of Accidents
0
2
4
6
8
10
12
14
61 - 62
62 - 63
63 - 64
64 - 65
65 - 66
66 - 67
67 - 68
68 - 69
69 - 70
70 - 71
71 - 72
72 - 73
Mile Posts


SR 198 Wild Animal Hits
2003-2005
Number of Accidents
0
2
4
6
8
10
12
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
Mile Posts

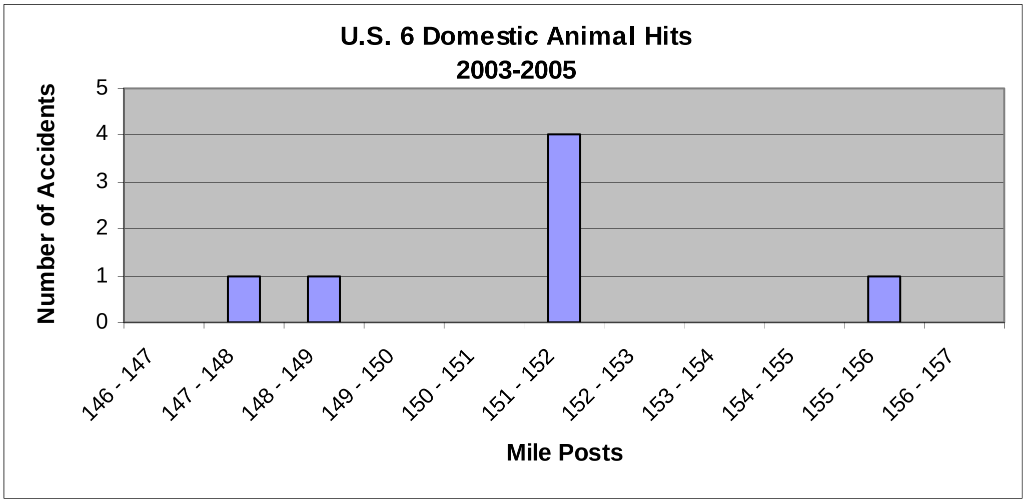

SR 201 Wild Animal Hits
2003-2005
Number of Accidents
0
2
4
6
8
10
12
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
Mile Posts

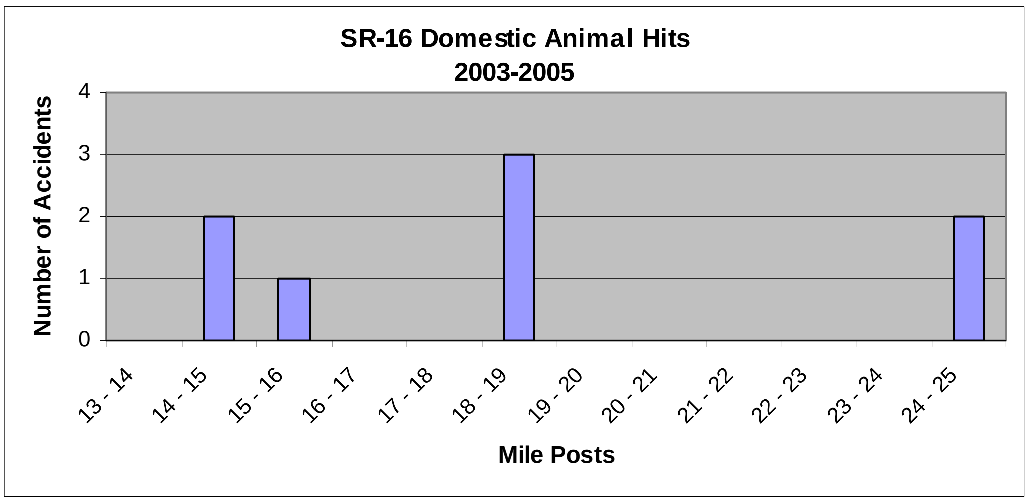

SR 203 Wild Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
5
6
7
8
9
10
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
Mile Posts

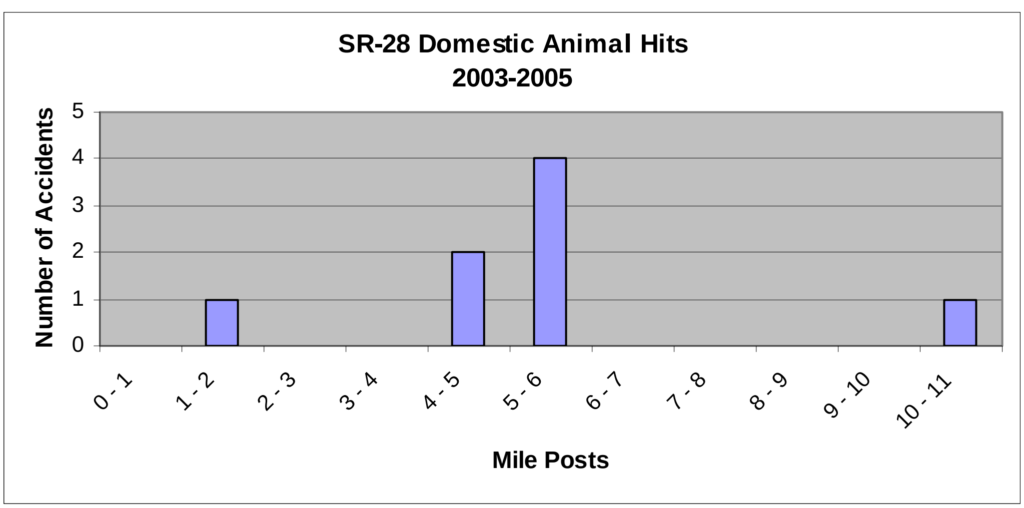

SR 224 Wild Animal Hits
2003-2005
Number of Accidents
0
5
10
15
20
25
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
11 - 12
12 - 13
13 - 14
Mile Posts

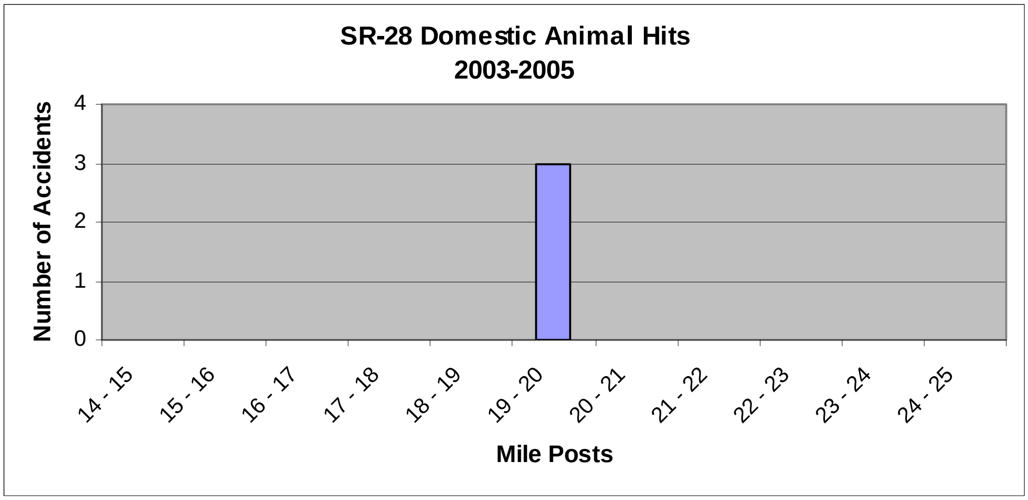
APPENDIX B

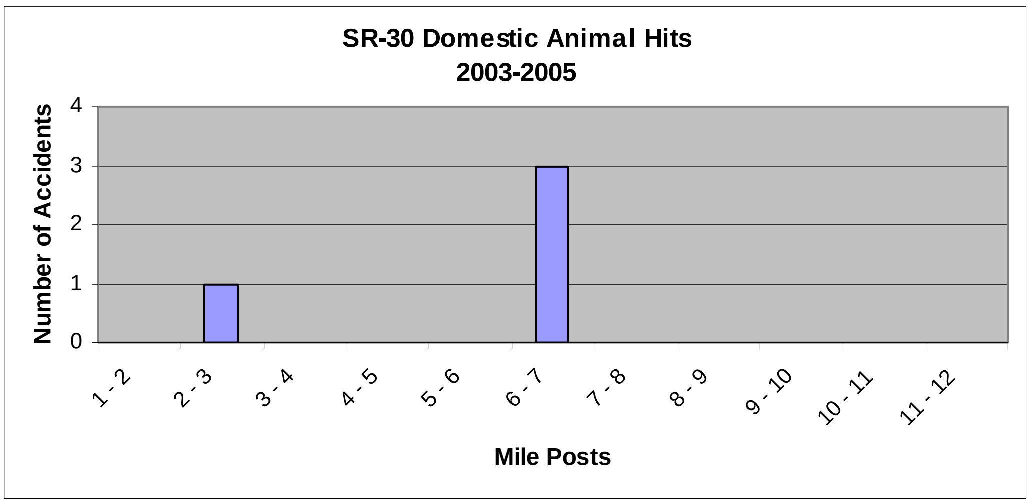
Domestic Animal Hits

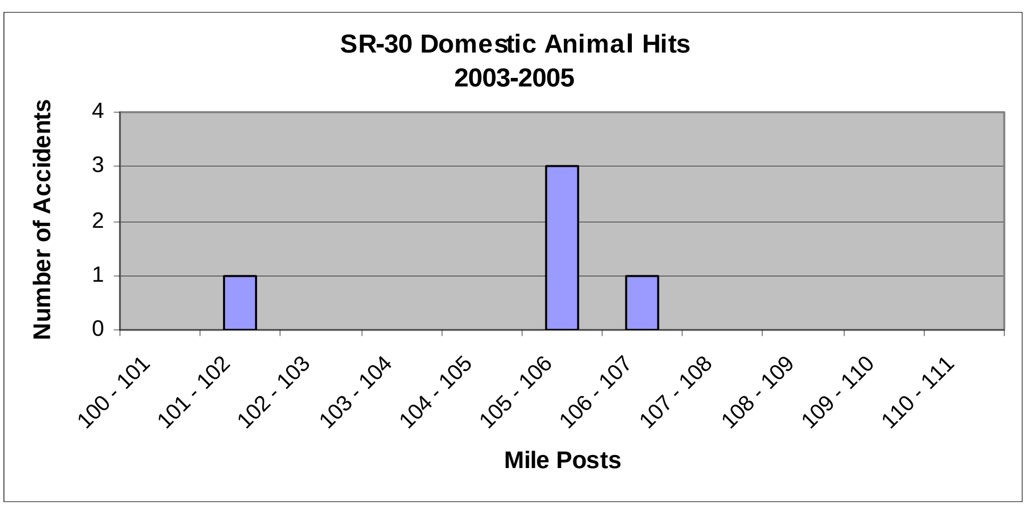

U.S. 6 Domestic Animal Hits
2003-2005
Number of Accidents
5
4
3
2
1
0
146 - 147
147 - 148
148 - 149
149 - 150
150 - 151
151 - 152
152 - 153
153 - 154
154 - 155
155 - 156
156 - 157
Mile Posts

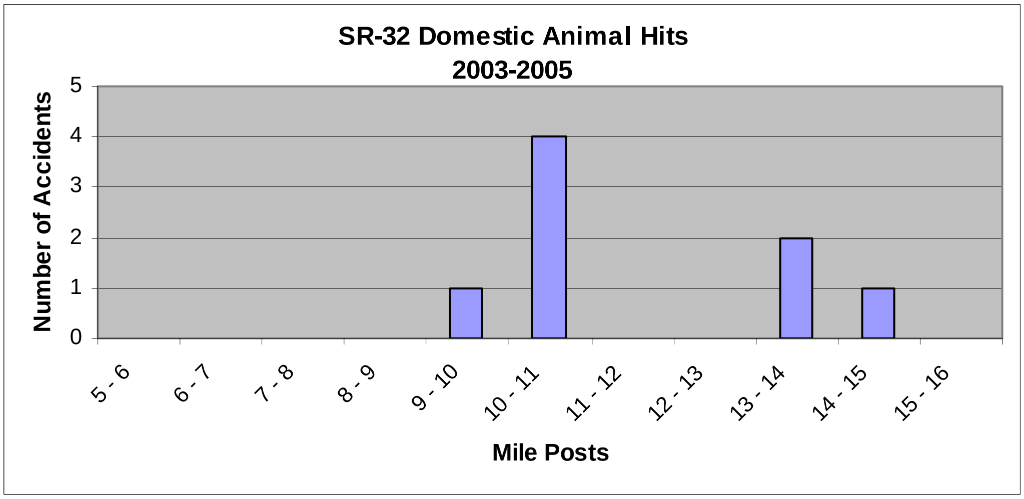

SR-16 Domestic Animal Hits
2003-2005
Number of Accidents
4
3
2
1
0
13 - 14
14 - 15
15 - 16
16 - 17
17 - 18
18 - 19
19 - 20
20 - 21
21 - 22
22 - 23
23 - 24
24 - 25
Mile Posts

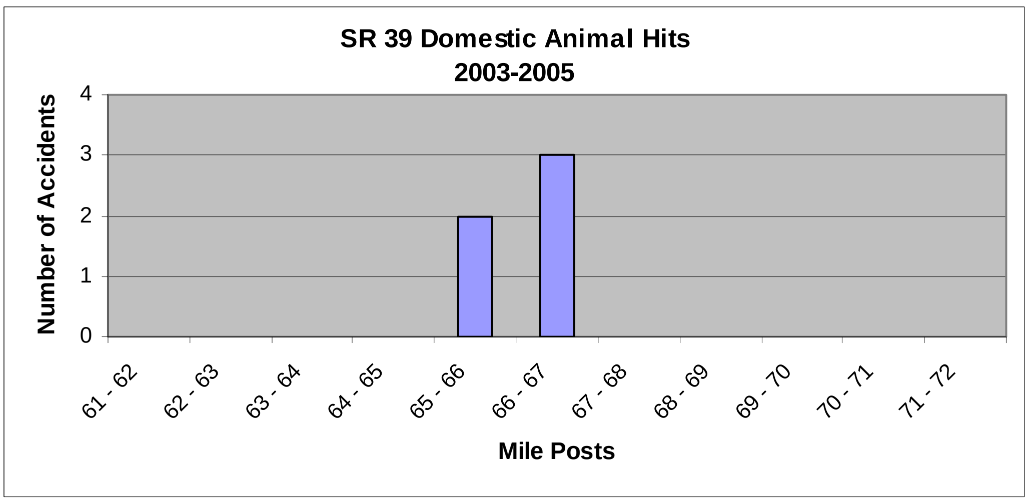

SR-28 Domestic Animal Hits
2003-2005
Number of Accidents
5
4
3
2
1
0
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
Mile Posts

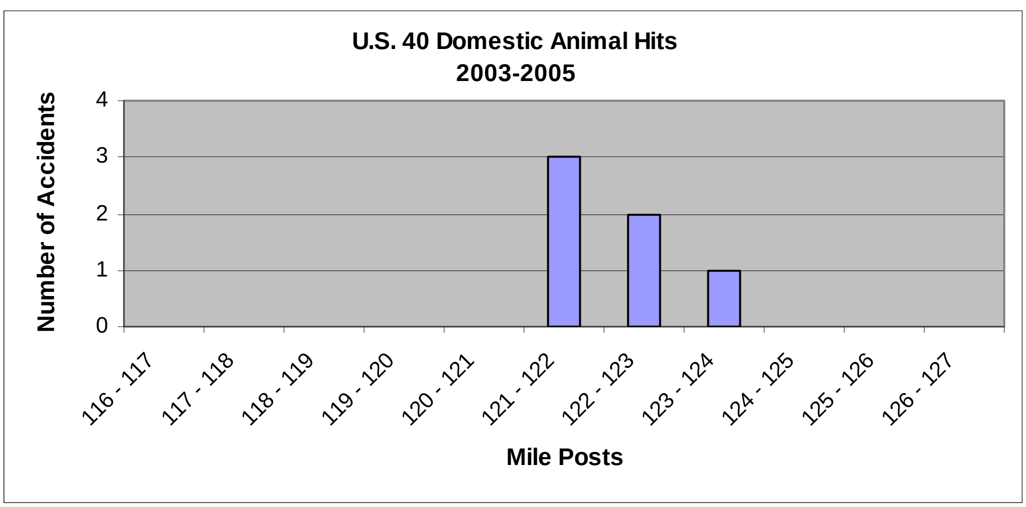

SR-28 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
14 - 15
15 - 16
16 - 17
17 - 18
18 - 19
19 - 20
20 - 21
21 - 22
22 - 23
23 - 24
24 - 25
Mile Posts

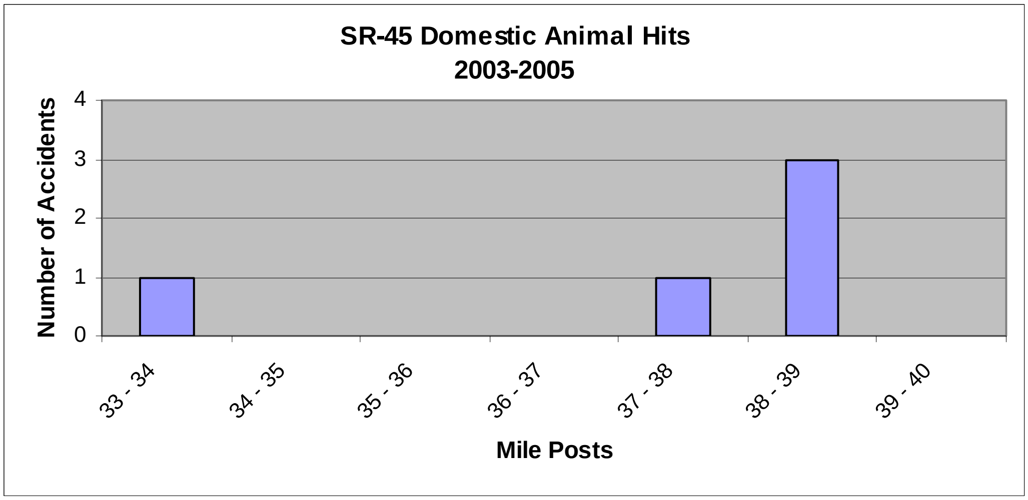

SR-30 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
11 - 12
Mile Posts

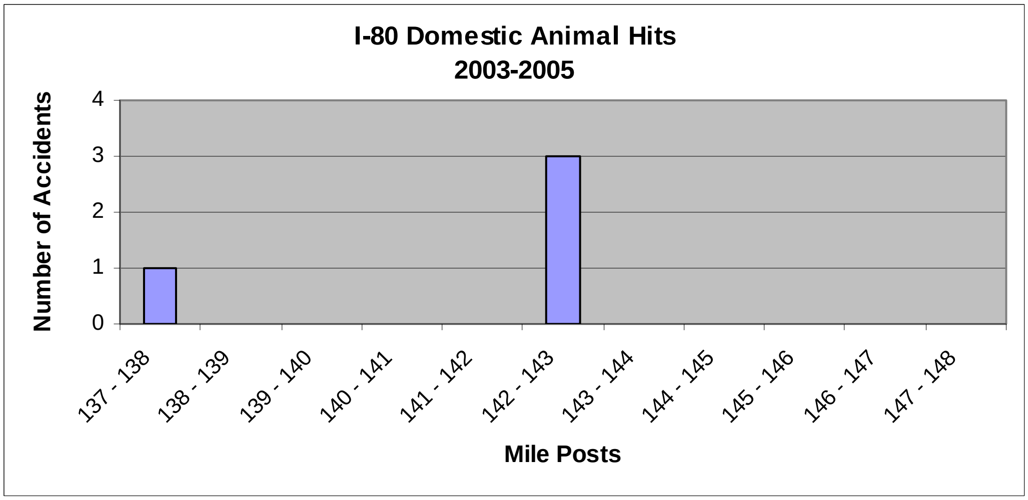

SR-30 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
100 - 101
101 - 102
102 - 103
103 - 104
104 - 105
105 - 106
106 - 107
107 - 108
108 - 109
109 - 110
110 - 111
Mile Posts

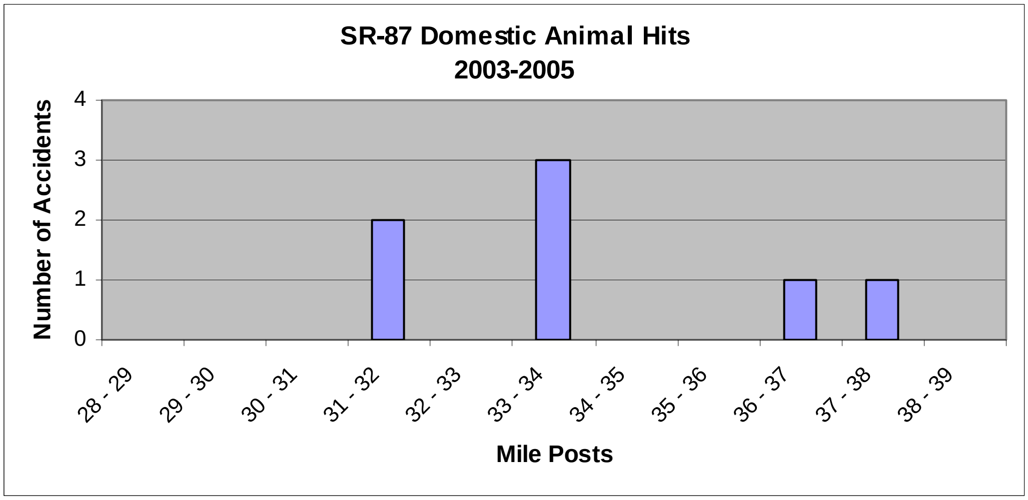

SR-32 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
11 - 12
12 - 13
13 - 14
14 - 15
15 - 16
Mile Posts

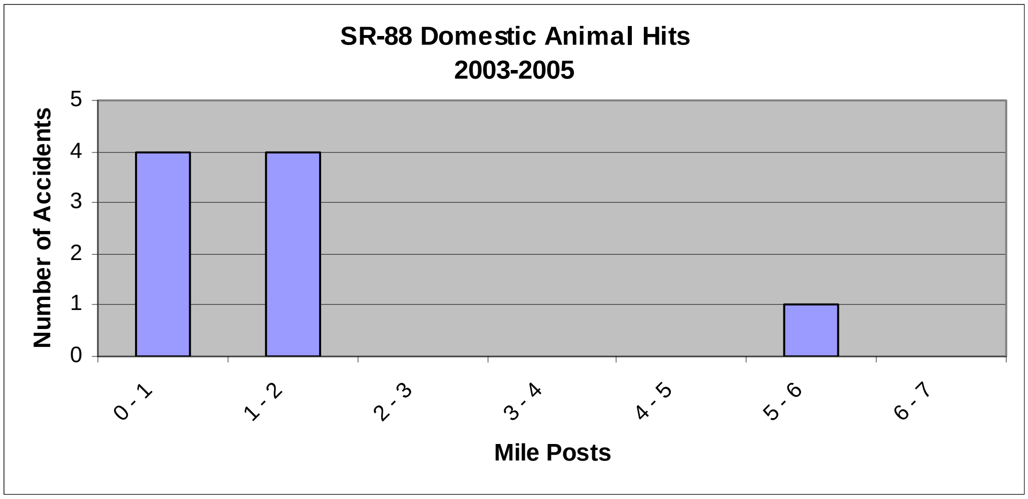

SR 39 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
61 - 62
62 - 63
63 - 64
64 - 65
65 - 66
66 - 67
67 - 68
68 - 69
69 - 70
70 - 71
71 - 72
Mile Posts

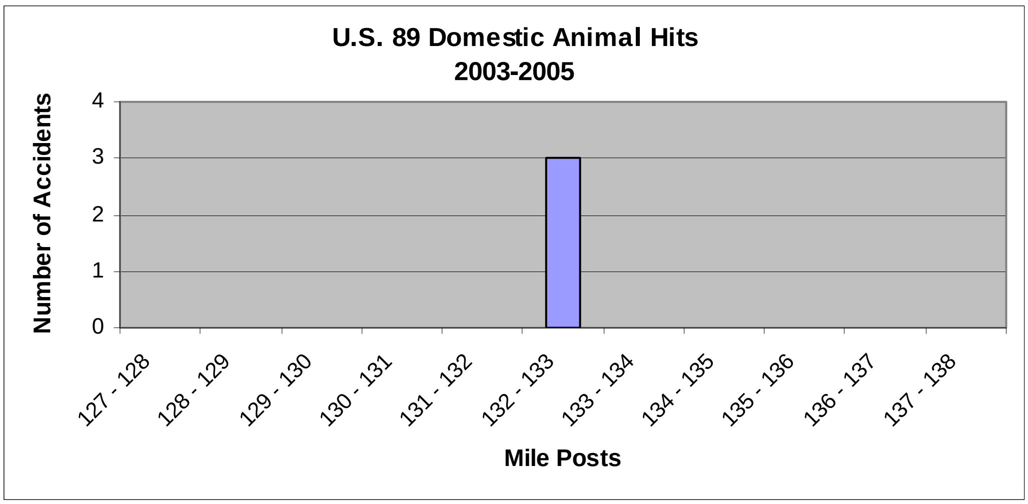

U.S. 40 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
116 - 117
117 - 118
118 - 119
119 - 120
120 - 121
121 - 122
122 - 123
123 - 124
124 - 125
125 - 126
126 - 127
Mile Posts

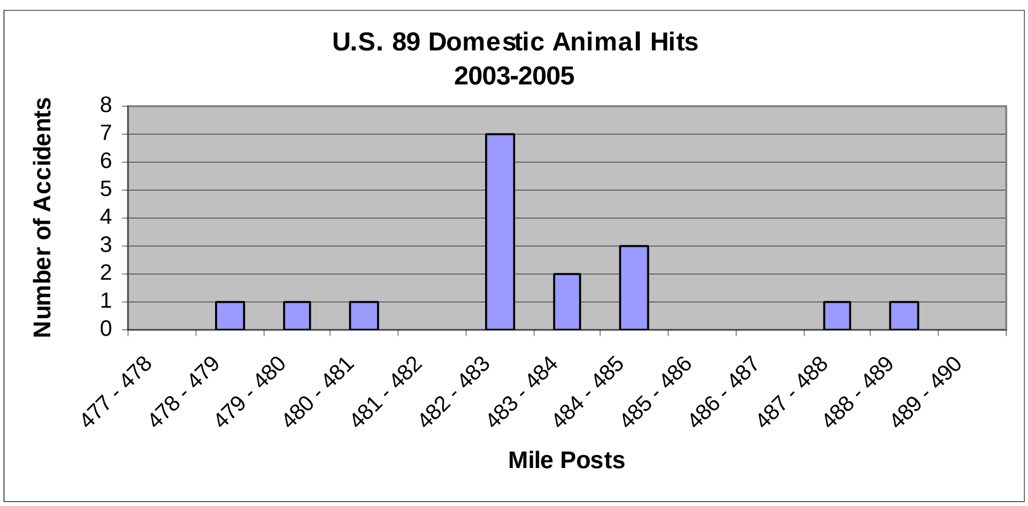

SR-45 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
33 - 34
34 - 35
35 - 36
36 - 37
37 - 38
38 - 39
39 - 40
Mile Posts

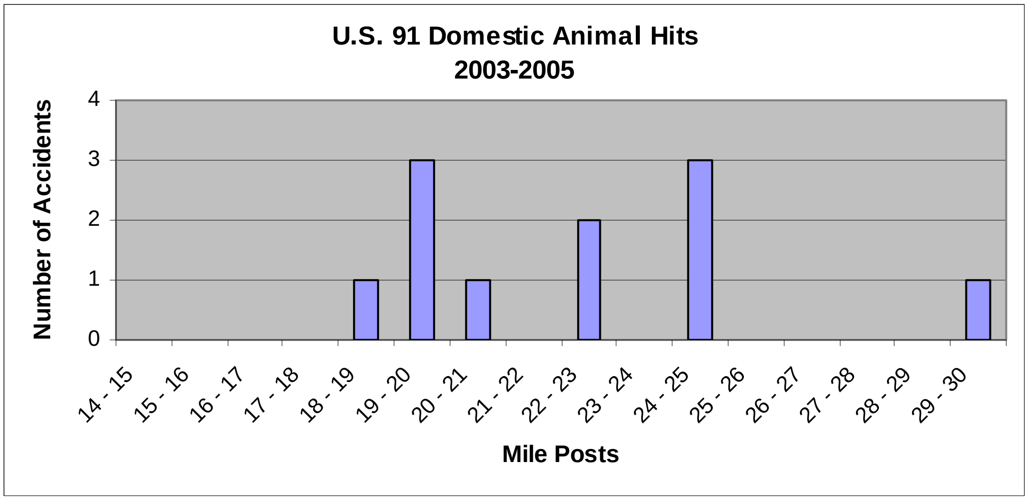

I-80 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
137 - 138
138 - 139
139 - 140
140 - 141
141 - 142
142 - 143
143 - 144
144 - 145
145 - 146
146 - 147
147 - 148
Mile Posts


SR-87 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
28 - 29
29 - 30
30 - 31
31 - 32
32 - 33
33 - 34
34 - 35
35 - 36
36 - 37
37 - 38
38 - 39
Mile Posts

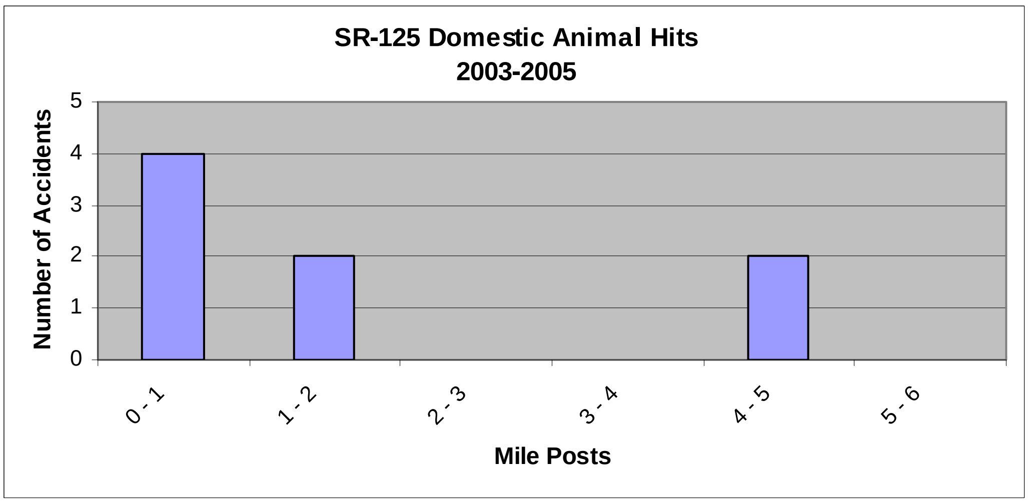

SR-88 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
5
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
Mile Posts


U.S. 89 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
127 - 128
128 - 129
129 - 130
130 - 131
131 - 132
132 - 133
133 - 134
134 - 135
135 - 136
136 - 137
137 - 138
Mile Posts

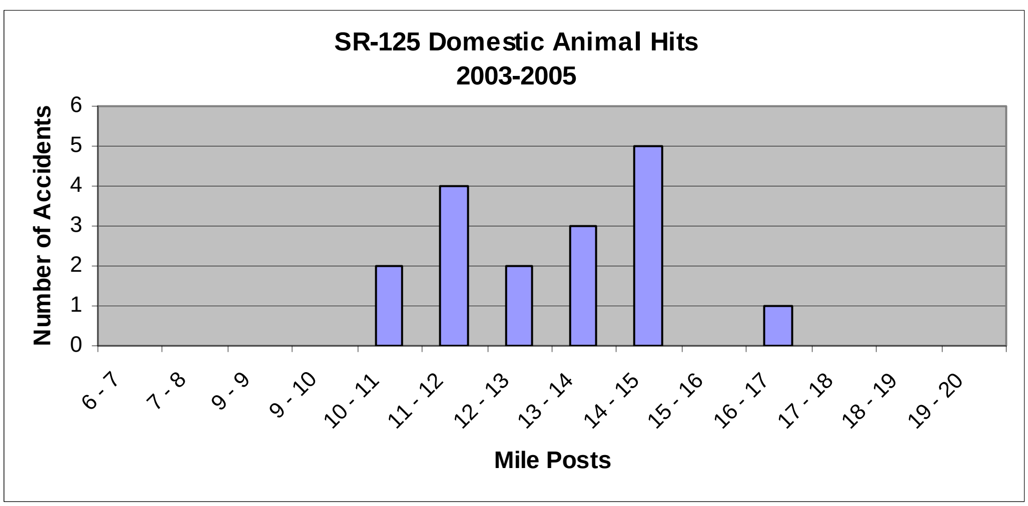

U.S. 89 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
5
6
7
8
477 - 478
478 - 479
479 - 480
480 - 481
481 - 482
482 - 483
483 - 484
484 - 485
485 - 486
486 - 487
487 - 488
488 - 489
489 - 490
Mile Posts



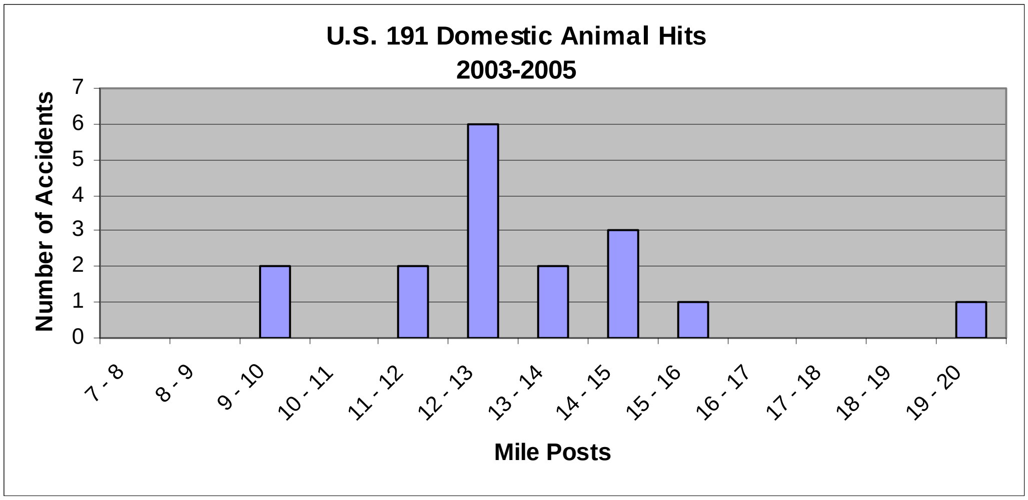
U.S. 91 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
14 - 15
15 - 16
16 - 17
17 - 18
18 - 19
19 - 20
20 - 21
21 - 22
22 - 23
23 - 24
24 - 25
25 - 26
26 - 27
27 - 28
28 - 29
29 - 30
Mile Posts

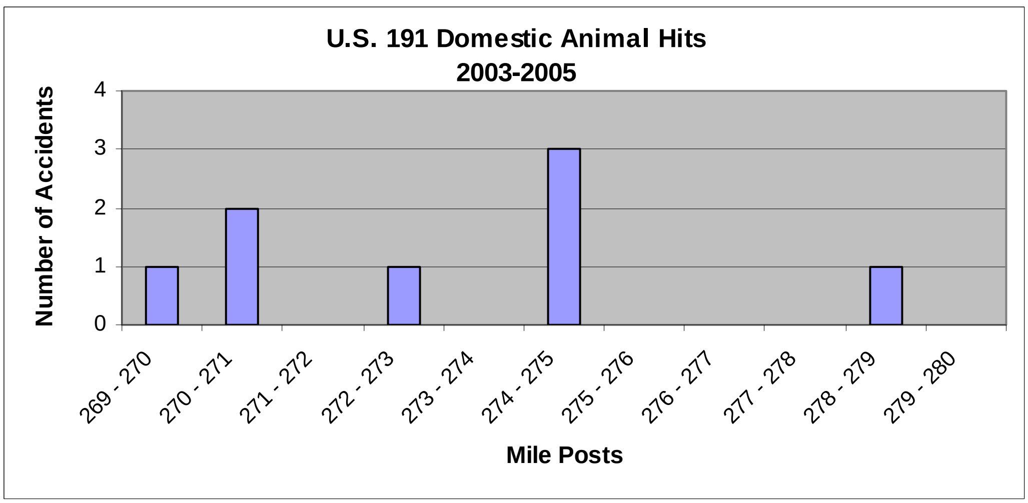


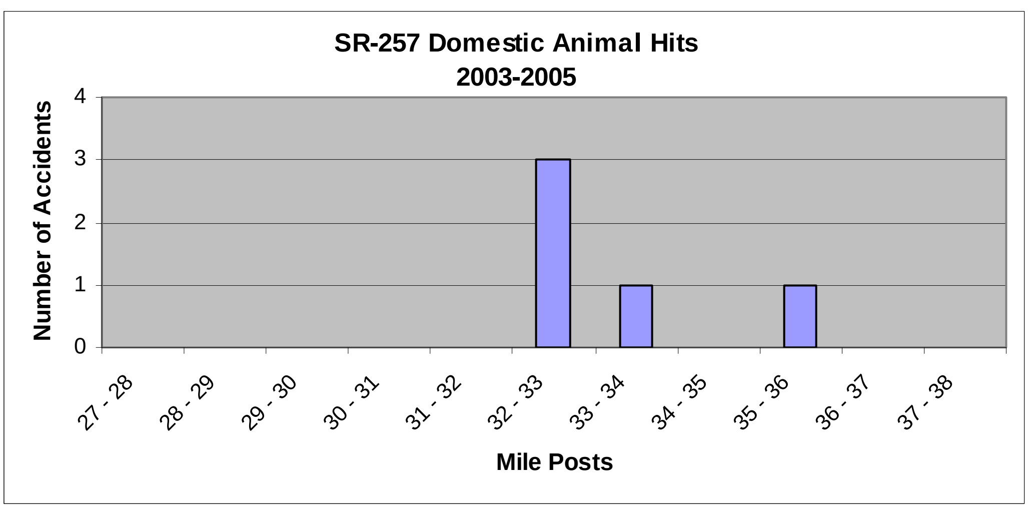
SR-125 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
5
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
Mile Posts



SR-125 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
5
6
6 - 7
7 - 8
9 - 9
9 - 10
10 - 11
11 - 12
12 - 13
13 - 14
14 - 15
15 - 16
16 - 17
17 - 18
18 - 19
19 - 20
Mile Posts


U.S. 191 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
5
6
7
7 - 8
8 - 9
9 - 10
10 - 11
11 - 12
12 - 13
13 - 14
14 - 15
15 - 16
16 - 17
17 - 18
18 - 19
19 - 20
Mile Posts


U.S. 191 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
269 - 270
270 - 271
271 - 272
272 - 273
273 - 274
274 - 275
275 - 276
276 - 277
277 - 278
278 - 279
279 - 280
Mile Posts


SR-257 Domestic Animal Hits
2003-2005
Number of Accidents
0
1
2
3
4
27 - 28
28 - 29
29 - 30
30 - 31
31 - 32
32 - 33
33 - 34
34 - 35
35 - 36
36 - 37
37 - 38
Mile Posts

APPENDIX C

Recent UDOT Research Studies

Following, are selections of studies that can help to understand the problems associated with wildlife and domestic animal accidents, along with recommendations of possible solutions:

1) Abstract for UDOT Research Study Report No. UT-03.31 “Animal-Vehicle Accident Analysis” Authored by Dr. Joseph Perrin and Rodrigo Disegni of the University of Utah, November 2003.

Vehicle-animal accidents represented 4.6% of U.S. automobile accidents (in 2001) with more than 1.5 million accidents a year, 150 deaths, and $1.1 billion in vehicle damage. Animal related accidents in Utah represent 1.2% of statewide automobile accidents. In 2001, there were 2,688 vehicle-animal collisions, including 3 deaths, and 235 injuries. In Utah, animal related accidents are subdivided into wild and domestic animals. Domestic animals include livestock, such as cows and sheep or horses. Wild animals most often refer to deer, elk, and moose.

Using 10-year statewide accident information, the problem locations were identified and a comparison between domestic and wild animal accidents based on severity was examined. The accident analysis determined that domestic animal accidents represent only 16% of the animal-vehicle accidents but are more severe than wild animal accidents. Domestic animal accidents result in injury 23% of the time while wild animal accidents result in injury only 7% of the time. When a motorcycle is involved, it was found the 94% of the animal-motorcycle related accidents resulted in injury compared with only 11% of the non-motorcycle-animal accidents.

Overall, there is a 7.9 times greater chance of a fatality with domestic animal accidents compared to wild animals accidents. This is attributed to the height and weight of domestic animal relative to the common wild animal.

While many countermeasures are attempted, such as whistles and reflectors, the principal countermeasure to control animal related accidents has been the use of fences along the roads. The 4-foot high right-of-way fences are effective for domestic animals, but wildlife animals require higher, 8-foot fences since deer can easily circumvent 4-foot fences. Alternative countermeasures such as one-way deer gates and eco-passages are also reducing wild animal hits.

This study utilizes UDOT’s Crash Analysis Reporting System (C.A.R.S.) accident database to identify the vehicle-animal crash problem in Utah. The study describes the extent of the problem; some literature on various countermeasures used throughout the world, and finally identifies the most dangerous sections of routes between the years 1999-2001 in terms of the accidents per mile for wild and domestic animals.”

2) Utah State University, through the efforts of Dr. John Bissonette and his graduate research students has extensively evaluated deer-vehicle collisions in Utah.

Dr. Bissonette has also been working with Larry Cook, Utah CODES Director, at the University of Utah Intermountain Injury Control Research Center, School of Medicine to address linked databases. Here are the figures and some of the recommendations they have come up with as emailed to UDOT in June 2005.

The overall cost of 13,020 collisions from 1996 – 2001 in Utah was $45,175,454, resulting in an estimated average per year cost of $7,529,242 and an overall per crash value of $3,470. Contributions to total costs varied widely. Estimated human fatality costs of $24 million accounted for 53%. Vehicle damage costs of $17,521,970, accounted for 39%. Deer loss, valued at $2,651,083, totaled 6%. And human injury costs of $1,002,401 accounted for 2% of total costs.

Between 1996 and 2001, Utah had an average of 2,170 deer-vehicle collisions each year accounting for 4.0% of all vehicle collisions that occur each year. When property damage, human injury and death, and wildlife losses are combined, we estimated an overall cost of about $7,529,242 per year. If only 1/6 (Decker, Loconti-Lee, & Connelly, 1990) to 1/2 of all deer-vehicle collisions are actually reported (Romin, 1994), the impacts of DVCs could be far greater than what we calculated. (Romin & Bissonette, 1996).

Our data supports the findings of the CDC (2004): more people were injured in deer-vehicle collisions during the fall and the dawn and dusk hours when animals are more active. We suggest that mitigation measures, including driver education and outreach, should take into account the temporal patterns associated with DVCs. Placing crossings based on the analysis of collision data should increase the efficacy of the crossing structures, thereby decreasing wildlife-vehicle collisions and increasing public safety. The Center for Disease Control (CDC) reported that nonfatal wildlife-vehicle related injuries accounted for <1.0% of the approximately 3 million people treated in U.S. emergency departments annually due to motor-vehicle related injuries (2003). However, the CDC also argued that wildlife-vehicle collisions and associated consequences, including property damage, wildlife loss, and human injury and death, are important concerns in rural locations with large deer populations (2003). It is clear that the ecological, social, and economic consequences of animal-vehicle collisions make this an important issue in Utah and across the country."

3) Sakaguchi, Doug, & Anis Aoude, wildlife biologists with Utah Division of Wildlife Resources. July 8, 2005. Road kill information for Highway 6, from I-15 to I-70 Utah Department of Natural Resources, Division of Wildlife Resources, Springville, Utah *(This report on U.S. 6 wildlife accidents was written for, and presented to UDOT by Doug Sakaguchi and Anis Aoude, and is solely their opinion).*

Anis Aoude, with the UDWR, requested and received road-kill pickup information from UDOT Region 3 for the years 2001 through the first half of 2005. For dead animals picked up along highways, UDOT contractors submit reports of road-killed animals, by highway, mile post and date. This raw data was entered into spreadsheets by year, and pages were created for each highway for which data existed. Twelve months of data (complete year) were available for only the years 2002 and 2004. (These spreadsheets are currently available electronically from Doug Sakaguchi at the following e-mail address: dougsakaguchi@utah.gov.)

For Highway 6 (I-15 at Spanish Fork to I-70 near Green River, mile posts 174 to 290, respectively), the complete road kill pick up information (2002 and 2004 data) is shown in Table 6. (Information for the partial years of 2001, 2003, and 2004 are shown in Table 7 at the end of this report.)

Table 6 Highway 6, (from I-15 in Spanish Fork to I-70 near Green River, mile posts 173 to 290, respectively), big game mortality summary, 2002 and 2004.

YEAR	Months	No. of Months	Mile Posts	Deer Doe	Deer Buck	Total Deer	Elk Cow	Elk Bull	Total Elk	Total Big Game Killed
2002	Jan-Dec	12	176-276	294	74	**368**	43	6	**49**	**417**
2004	Jan-Dec	12	174-270	385	160	**545**	37	8	**45**	**590**

UDOT road kill data for years 2002 and 2004 shows 417 and 590 big game animals were hit by vehicles, died along the highway and were picked up by UDOT contractors during the respective years. These are a minimum number of animals that were directly impacted by vehicle collisions on Highway 6 between mileposts 174 to 276. Some animals die beyond the highway right of way, which are not included in numbers submitted by UDOT's contractors; others may survive but remain crippled through the rest of their lives; during the winter and spring, pregnant doe deer and cow elk are carrying fetuses and are generally counted as only one dead animal.

The Draft EIS (DEIS) for Highway 6 (September 2004), using reported accidents on the highway from 1991 through 2001, state that only an average of 110 wildlife-vehicle accidents (wildlife strikes) occur annually (page 1-7) along this section of Highway 6. Granted, the years for which reported accidents and road kill pick up data were collected were not concurrent, but they were all collected within the last 15 years.

The DEIS further states that reported accident wildlife strikes are only 28% of the reported accidents on Highway 6, that there are no human fatalities associated with wildlife strikes, and that only 6% of wildlife strikes result in personal injury.

However, the data collected by UDOT contractors show that there are between 4 to 6 times the number of wildlife strikes (dead animals) annually that actually on Highway 6 than are being considered wildlife strikes in the DEIS for Highway 6 road improvements. Rather than only 110 wildlife strikes occurring, based on 2002 and 2004 complete data, there are more likely between 400 to 600 wildlife strikes annually on Highway 6, even though the majority of them are not being reported. This corresponds with Kassar and Bissonette's (2005) estimate of only 1/2 to 1/6 of vehicle strikes reported versus actual wildlife strikes. With higher speeds, increased traffic volumes, and wider lanes of traffic for animals to cross, the number of wildlife strikes will surely increase in the future. Kassar & Bissonette also list growing numbers of vehicles, increasing miles traveled, and increases in population as additional factors that will affect traffic volume, and lead to increased vehicular strikes.

Road kill pick up along U.S. 6 (between mileposts 173 to 290), in 2002, numbered 417 animals, of which 368 were mule deer. Kassar and Bissonette (2005) found that there were a minimum of 2,205 reported vehicle strikes state wide on Utah highways between 1992 and 2002, and a maximum of 2,577 reported vehicle strikes, annually. The number of road-killed mule deer picked up along Highway 6 in 2002 make up between 14.3% and 18.2% of the total number of vehicle strikes (deer) reported annually throughout the entire state!

Road-kill pick up data show that vehicle strikes to mule deer and elk create 4 to 6 times the number direct impacts than are presented in the DEIS for Highway 6. UDWR should take a firm position on adequate wildlife crossing structures, associated big game fencing, highway escape ramps, habitat enhancement, etc., in an effort to mitigate for such large numbers of vehicle strikes that result in large numbers of dead wildlife.

Reference cited: Kassar, C. and J.A. Bissonette. 2005. Deer-Vehicle Crash Hotspots in Utah: Data for Effective Mitigation. UTCFWRU Project Report No. 2005(1):1-128. Utah Cooperative Fish and Wildlife Research Unit, Utah State University, Logan Utah.

Table 7 Highway 6: I-15 to I-70 (MP 173 to MP 290) Big Game Mortality Summary. Years for which monthly data was not complete, and which are extrapolated to estimate annual big game road kill pick ups by UDOT contractor.

Partial YEAR	Months Data -- where available	No. of Months	Mile Posts	Deer Doe	Deer Buck	Total Deer	Elk Cow	Elk Bull	Total Elk	Big Game Killed
2001	Jan-Feb, Aug, Nov-Dec	5	176-276	40	19	59	20	1	21	80
extrapolated 2001*	**5/12 year**			(96)	(46)	(142)	(48)	(2)	(50)	(192)
2003	Jan-Mar; Sep-Dec	7	176-281	188	70	258	11	4	15	273
extrapolated 2003*	**7/12 year**			(324)	(121)	(445)	(19)	(7)	(26)	(471)
2005	Jan-May	5	176-242	133	50	195**	17	11	28	223
extrapolated 2005*	**5/12 year**			(319)	(120)	(329)	(41)	(27)	(68)	(397)

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